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REPORT OF OBSERVATIONS

OF

INJURIOUS INSECTS

AND

COMMON FARM PESTS,

DURING THE YEAR 1893,

WITH METHODS OF

PREVENTION AND REMEDY.

SEVENTEENTH REPORT.

BY

ELEANOR A. ORMEROD, F. R. Met. Soc.

FELLOW OF THE ENTOMOLOGICAL SOCIETY; MEMBER OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON;
ALSO
MEMBER OF THE ASSOCIATION OF OFFICIAL ECONOMIC ENTOMOLOGISTS,
WASHINGTON, U.S.A.;
HON. MEM. OF FARMERS' CLUB; HON. AND CORR. MEM. OF ROYAL AG. AND HORT. SOC.,
S. AUSTRALIA; HON. MEM. OF ENT. SOC. OF ONTARIO, AND CORR. MEMBER OF
FIELD NAT. CLUB OF OTTAWA, CANADA; MEMBER OF EASTERN PROVINCE
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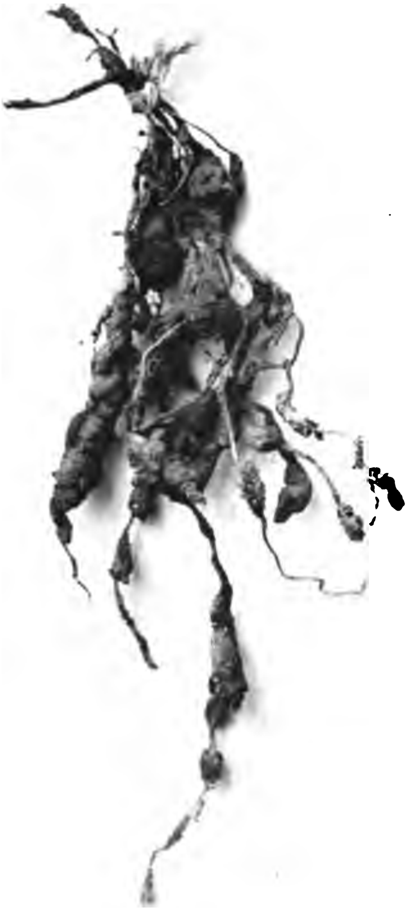

West, Newman photo.

TOMATO-ROOTS

Galled by attack of *HETERODERA RADICICOLA*,
about two-thirds natural size.

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TOMATO [illegible]

[illegible]

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REPORT OF OBSERVATIONS

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PREFACE.

The past season of 1893, looked at from the point of agricultural entomology, has been remarkable for the effects of the unusual meteorological conditions (notably the long-continued drought) on the amount of various kinds of insects, and of other crop and fruit and forest infestations, and also the effects of this presence on the infested crops.

For those who wish to study the records of the 'Spring Drought of 1893,' much excellent information is given in the paper by Mr. G. J. Symons, F.R.S., published in Part II. of the fourth volume of the Journal of the Royal Agricultural Society*; but for just a short statement as a general guide to date, locality, and amount of deficiency of rainfall, the following few lines, extracted from the paper by Mr. Fred. J. Brodie, F.R.Met. Soc., entitled 'The Great Drought of 1893,' † may be serviceable in connection with some of the observations in the following Report on variation in amount of insect infestation.

Mr. Brodie observes:—"Enquiry showed that although an unusual amount of fine weather was experienced over England during the greater part of 1893, the drought itself was confined to the spring and early summer months. The finest and driest weather of all occurred in the ten weeks commencing with the beginning of March, and ending with the middle of May, but a great deficiency of rain continued in most districts until the end of June, and the period selected for investigation therefore included the whole of the four months, March, April, May, and June."

Further on in the same paper Mr. Brodie notes:—"Taking the period of four months as a whole, the aggregate rainfall amounted to less than half the average over the entire southern and eastern half of England, as well as in certain portions of Durham and Northumberland. Over a considerable portion of our southern counties, as well as in Cornwall and South Wales, the fall amounted to less than one-third of the average; the only southern localities in which this proportion was exceeded being some of the more central parts of Devonshire."—(F. J. B.)

In the following Report it will be found that the severity in

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* 'The Spring Drought of 1893' (with Tables and Maps), by G. J. Symons, F.R.S. Journal of the R. A. S. E., Third Series, Vol. 4, Pt. II., pp. 339—354.

† See 'The Great Drought of 1893,' by F. J. Brodie, F.R.Met. Soc. Pt. IV. of Vol. quoted above, pp. 849—856.

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amount, or peculiar development, of some kinds of crop injury as of that caused by Gout Fly Maggot, pp. 6—11, is clearly referable to unfavourable circumstance for plant growth, laying the plants more than ordinarily under the power of the maggot; in others, as with the Gooseberry Red Spider, pp. 32—38, the amount of progagation was favoured by weather which left the myriads of pests unharmed by soaking or clearing rains; and the great prevalence of Wasps was another entomological visitation obviously in great part due to the absence of unfavourable weather at the time of commencement of their settlements; prevalence of Aphides was also favoured by the same conditions.

In the course of the year, I received enquiries regarding about (or upwards of) 145 distinct species of infestation; these for the most part asking information regarding field and orchard insect pests, but including among them what are often known as insect allies, as the "False Wireworms," or Millepedes; Gall Mites, and Red Spider, belonging to the Acarina; "Stem" and "Root-knot" Eelworms (scientifically, Nematodes); and also the excessively minute six-legged creatures belonging to the division of the "Springtails" (scientifically, *Collembola*), which do mischief to roots underground, and in various other ways, and of which both the leaping and non-leaping species were sent me.

Amongst crop attacks, the points regarding Mangolds which were sent me included Leaf-maggot, Surface Caterpillars, Aphides, and the "Pigmy" Mangold Beetle noticed in my Report for 1892, which was again reported to me by Prof. Harker, from the Royal Agricultural College, Cirencester; Mustard was infested in various localities by its different beetle enemies, from the sprouting of the seed in the ground to its final flowering and seed stages; Peas, Beans, and Vetches had their respective attacks, mostly of beetle infestation in the seed for sowing, or of another kind of weevil, the *Sitones*, on the leafage, or of Aphides smothering the plants,—this latter damage to the Beans being in some instances little lessened, and that to the reapers very much increased, by the numbers of Wasps attracted to the "Plant Lice."

Corn, taken generally, did not appear to be seriously attacked, although Barley suffered greatly in some places from Gout. Frit Fly Maggot was also present; and Hessian Fly was a little reported to me, the first record being sent by Mr. D. D. Gibb, from Ossemsley Manor Farm, Lymington, Hants, received June 27th. Attack of maggot of Corn Sawfly was not once reported; but it certainly did occur to me whether if one or two instances, where serious damage to crop by Hessian Fly was reported, it might not have turned out (as sometimes in 1887), if more critically examined, to be in part due to the falling of the straw from Sawfly Maggot presence. Aphis attack was little reported on any kind of corn. Various moth and weevil attacks to corn stacked, or in granaries, were more noticed than is commonly the case.

Grass suffered very severely (see pp. 22—31) in various places, especially in the south-east of England, from the maggots of Rose Chafer, an attack liable to be confused with that of the Cockchafer; and a little moth, without any very descriptive popular name (scientifically, the *Pyralis glaucinalis*), was found in one locality infesting the outer portions of hay, and other kinds of fodder, stacks, to an inconvenient extent.

The infestation of Diamond-back Moths, which in 1891 caused so much mischief to Turnip and Cabbage leafage, especially along our eastern coasts, and which were to some extent present in 1892, was hardly reported last year; and where careful examination was made, by request, in the districts round Hartlepool and King's Lynn, where it had been especially prevalent, the infestation was last year notably absent. Other common pests were present, as Surface Caterpillars of different kinds, Cabbage-root grubs, Aphides, &c.; these last in one instance to such a great amount as to attract such vast numbers of Ladybirds (*Coccinellidæ*), that measures were being set on foot to destroy these helpers as being the cause of the mischief! On Hops also (which suffered so severely in some places from Red Spider that the cutting had to be hastened), a very small kind of Black Ladybird, the *Scymnus minimus*, was found to be very serviceably at work as a "Red Spider" eater.

The "Root-knot" Eelworm, *Heterodera radicicola*, affecting Cucumber and Tomato roots, has been made the subject of very careful experiment regarding effects of chemical applications to infested soil or plants (see pp. 103—108).

Onions (which were much attacked by maggot last year), Carrots, Potatoes, and other ordinary field and garden crop infestations, were enquired about in their season, as well as forest injuries, amongst which Aphis attack in various forms, and notably the troublesome Larch Chermes, were present. These were all duly replied to as they occurred, and entered, with date and name of sender, in my books, which now have been daily kept for many years, so as to form a kind of index of reference. But as the main points of the history and methods of prevention (so far as known) of our common attacks which have been entrusted to my care for publication have been in many cases embodied in my Annual Reports, of which the present is the seventeenth of the series, it has seemed unnecessary to repeat the observations.

Therefore in this year's Report I have endeavoured, so far as I could, to omit notice of the well-known attacks, excepting where some additional point of information, or some peculiar development coincident with the peculiar weather conditions of the year, appeared worth noting.

Amongst attacks injurious to the fruit industry which now holds such an important position, it might be said that almost each kind of orchard tree, or bush, or ground-growing fruit, had its customary infestations, with some not usually present. Amongst the latter was the appearance of the magnificent caterpillars of the Lappet Moth, four inches or more in length, on Apple; and the great prevalence of the kind of Red Spider, usually infesting Ivy, on Gooseberry; and, also on Gooseberry, some observations of the so-called Currant Scale Insect.

Locusts, as an import in hay, or fodder, have come more under notice than usual; and under the heading of *Phytoptidæ* will be found notes on the Gall Mites, with quotations and references to the exceedingly valuable series of publications now being issued by Dr. Nalepa on this difficult class of plant pests. Wasps also being a visitation which involves very universal trouble to everything they think fit to bestow their irritable or appropriative attentions on, are placed under the heading of their own name.

Warble prevention gains steady attention, and the distribution of leaflets (amongst other centres from the Irish Cattle Traders' Association) cannot fail to be doing good.

Besides home work, colonial applications were sent regarding insect infestations to tropical produce, as Sugar Canes, Oranges, Coffee, Tea, &c., these being sent through the hands of London correspondents of the infested districts in the West and East Indies, &c., or from owners, or societies, as the case might be.

In regard to such usefulness as my work may possess, I greatly wish to point out that this rests in great part primarily on the observations with which I am favoured by agriculturists, and other observers, of what they notice as to presence, and effects of infestations, and the treatment which demonstrably answers for getting rid of these; and I earnestly wish that our farmers and fruit-growers would bear more in mind that very often much of the treatment which they are advised to adopt is in reality the recorded result of their own practical experience.

To the agricultural press I am constantly indebted for their steady and encouraging support and assistance in my work; and also I beg to offer my grateful thanks for co-operation to the leading entomologists at home, whose assistance I have acknowledged in the papers connected with the insects which they have been good enough to aid me in identifying. I am also much indebted similarly to Dr. A. Nalepa, Professor at the Imperial Academy of Vienna, for his great assistance to me, and instruction bestowed on me, in connection with the difficult study of *Phytoptidæ;* also to Dr. Schöyen, State Entomologist, Christiania, for much useful entomological information kindly given, including information of the first recorded appearance of the Hessian Fly in Norway. To Dr. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, I am again (as each year) indebted for unfailing assistance in identification of Nematodes, commonly known as Eelworms, as well as kind co-operation; and to Senor Don Ignacio Bolivar, Professor of

Entomology at Madrid, I offer my sincere thanks for being good enough to identify for me the specimens of Locusts which I transmitted for benefit of his skilled opinion. With Mons. J. Danysz, Director of the Laboratory of Parasitology (Bourse de Commerce), Paris, I had the advantage of a little communication early in the year regarding the serious mill scourge, the Mediterranean Flour Moth (*Ephestia kuhniella*); and on his favouring me with a copy of his valuable pamphlet on the subject, it appeared to me that I could best co-operate in spreading information by requesting my booksellers to import (at my own risk) a certain number of copies, so that those concerned might see the subject *in extenso*, and the copies meeting with circulation, I have thought it unnecessary to enter on his information fragmentarily in my Report.

To Mr. J. Fletcher, Entomologist and Botanist of the Department of Agriculture, Experimental Farms, Canada, I am indebted for constant kind co-operation; and to the many other good friends who help me, who are too numerous to mention, I beg to offer my hearty thanks for their aid and encouragement. I should fail in courtesy if I did not also offer my best acknowledgments for the valuable and helpful gifts of entomological books (of which I am frequently in receipt), including amongst these the liberal gifts for which I am indebted to the courtesy of our own Canadian Government, and to the Department of Agriculture and Experimental Stations of the United States.

Of the 33 figures given in the following Report, those on pages 5, 6, 11, 22, 46, 54, 59, 60, 61, 62, and 95, are by kind permission of Messrs. Blackie & Son, Glasgow; the beautiful figure of the *Acridium americanum* at p. 51 is after a drawing by Prof. Riley; the Pear-leaf *Phytoptus*, and the feather-claws, p. 108, by kind permission of Dr. Nalepa; and the Pear Sawfly, p. 79, from one of the blocks I have been permitted to use by the proprietors of the 'Gardeners' Chronicle.' Of the remainder, the figures at pages 1, 15, 32, 39, 47, 74, and 84, are drawn (chiefly from life) during the past year for this Report.

It is a great gratification to me to find that the amount of insect enquiry sent to my hand, and which I think it a great honour to be entrusted with, increases rather than lessens in scope and in interest of points sent for examination; and it shall be my earnest attempt, by every attention that I can bestow on enquiries sent, to endeavour honestly and soundly to be of service.

ELEANOR A. ORMEROD,

F.R.Met.Soc., and F.E.S.

TORRINGTON HOUSE, ST. ALBANS,
February, 1894.

LIST OF

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NOTICED IN THE FOLLOWING REPORT.

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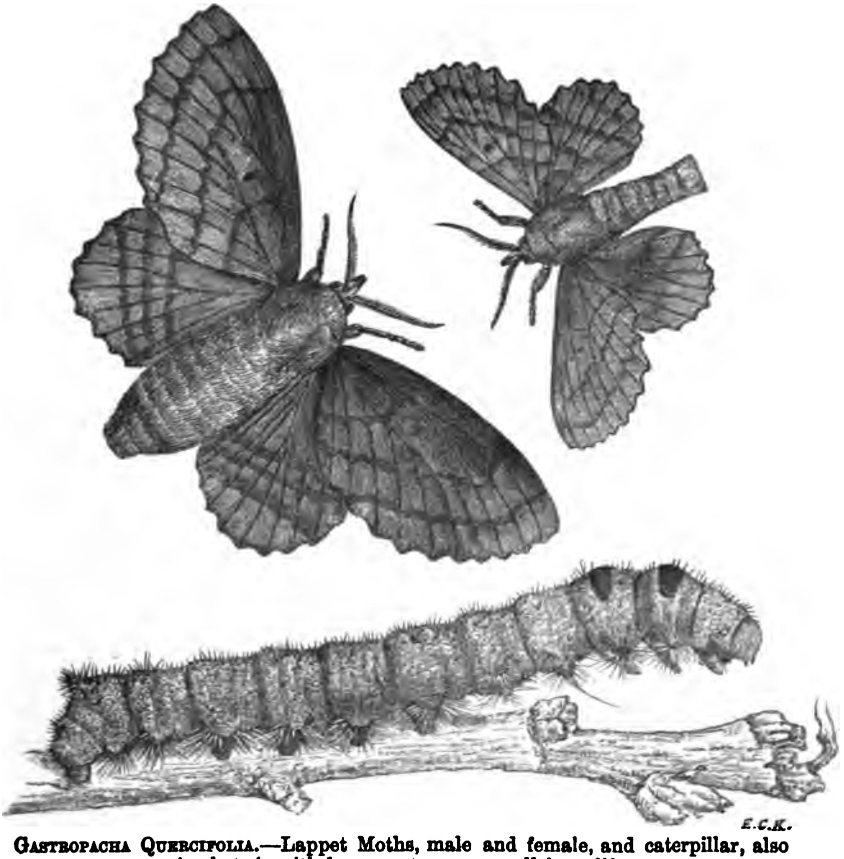
* The Minute Black Ladybird Beetle, the *Scymnus minimus*, is beneficial by destroying Red Spider. In the above list only the names of the chief infestations entered on in the following Report are specified.

NOTES OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON CROP PESTS
DURING 1893.

APPLE.

Lappet Moth. *Gastropacha Quercifolia*, Linn.



GASTROPACHA QUERCIFOLIA.—Lappet Moths, male and female, and caterpillar, also Apple twig with leaves eaten away; all from life.

The very conspicuous presence of the caterpillars of the Lappet Moth, which when full-grown reach a length of four inches or more, has long been known of in this country as occurring on Willow, also on Sloe or Blackthorn, and sometimes on Pear, and on Whitethorn; but it was not until last season that I had an observation of the infestation as seriously injurious to orchard leafage. In this case the attack was reported early in May to me by Messrs. Cranston, of King's Acre, near Hereford, as occurring here and there on their Apple trees, and that where they were found, every leaf had been devoured.

The little bundle of Apple twigs sent accompanying as samples of the ravage, showed this to have been total, as all was cleared excepting just the remains of the leaf-stem. The above sketch of part of one of the twigs sent me shows the extent of the injury, and the figure of the caterpillar, taken from a specimen which was the counterpart of the sample forwarded to me, shows its great size, and also shows the row of fleshy appendages along the side (fancifully compared to lappets), from which the perfect insect takes its popular name of "Lappet Moth."

The caterpillars of this "Lappet Moth" grow to a length of from four to five inches (the specimen before me is somewhat over four inches long), and are cylindrical, slightly hairy, and grey or brownish in colour, but the tint is variable, and so also is the pattern of the markings down the middle of the back. These may be almost absent, or may occur as a row of somewhat V-shaped dark marks; but across the back, on the segments next the head, are two beautifully lustrous, deep blue or purple, velvety bands. These are characteristic markings, and are especially observable when the caterpillar is in movement; when at rest they may be hardly noticeable. The caterpillars have three pairs of claw-feet, and four pairs of sucker-feet beneath the body, besides the pair at the end of the tail; and just above the feet, and all along each side is a row of fleshy warts or appendages with long grey hairs, to which the name of "lappets" has been given. These peculiar excrescences have been carefully figured from a specimen in my possession (by Mr. E. K. Knight), so that their position and form should be clearly distinguishable from that of the claw and sucker-feet, with which they are sometimes confused.

When full-grown, which may be in the late spring or early summer, the caterpillar spins a dark coloured oval cocoon, apparently in any convenient shelter, as the localities are variously recorded as being in clefts of bark, or between boards under eaves, or amongst the lower twigs of the plant on which the caterpillar fed, or close to the ground amongst grass. From these cocoons the moths appear at variable dates from June (or even as early as May) to July and August. These moths, scientifically the *Gastropacha Quercifolia*, are very fine insects, the females being sometimes as much as three inches and a quarter in the spread of the fore wings; of the two specimens before me, the female is just above three inches, the male just above two inches in expanse. The colours are rich brown, marked transversely on the fore wings with three irregularly disposed dark scalloped lines; the hinder wings are somewhat similarly marked, and the hinder margins of both wings scalloped or indented at the edge. When at rest, the fore edge of the hind wings, which is somewhat dilated, projects, so as to be very noticeable, beyond and from under the fore edge of the fore wing, thus giving an appearance much like a dead brown leaf to the moth, which probably often secures it from observation, and from which it takes its specific name of *Quercifolia*, or "Oak-leaf."

The early life-history of the caterpillars is stated to be for them to hatch in September, and to moult once, and to spend the winter extended on a twig of their food-plant, and in the following season to complete their growth. This autumn appearance of the young grub it will be seen agrees with what was considered to be the case in the course of the observations made at Messrs. Cranston's nurseries.

The first notes were sent me on the 8th of May, by Messrs. Cranston & Co., from King's Acre, Hereford, accompanying a fine nearly full-grown specimen of the grey variety of the caterpillar, sent as a sample of an infestation on their Apple trees. On the 15th of May they wrote further, and mentioned :—

"We have not discovered it upon our Apple trees until this season, nor has it been found in any considerable quantity, and only here and there have they attacked our young trees. Where they have been found every leaf has been devoured. I send you a few specimen branches which they attacked, and every vestige of leaf eaten. Our fruit-foreman thinks that the grubs are hatched in the autumn, for young caterpillars were found on the bark very early in the spring. We have not applied any remedy for getting rid of them, but simply hand-picked them where found."—(J. C.)

The shoots sent were as described, absolutely cleared of leaves, excepting that in a few instances some small remains of young leafage, in very miserable condition, were still existing, these being almost entirely at the ends of the twigs. For the most part, all had been thoroughly cleared down to a mere stump of even the leaf-stalk. The Apple shoots sent me were from about twelve to seventeen inches long, and of various ages up to young boughs of from three-eighths to half an inch in diameter.

Later on, on the 20th of July, Mr. Cranston further informed me that up to that date they had only discovered two of the moths, which had been observed about the end of June.

Prevention and Remedies.—On the Continent of Europe the attack of the Lappet caterpillars is much more destructive than with us, and is recorded as being often injurious there to young Plum trees, also to Pear, Apple, and Peach trees. But even there the mischief is stated to be less from their numbers than from their great size.

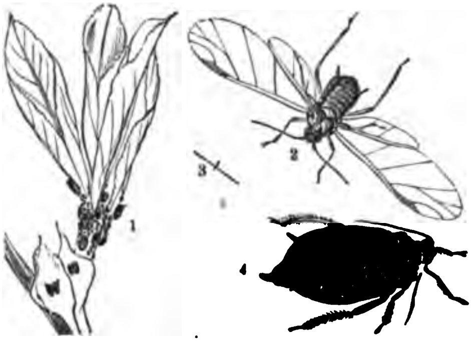
In this country probably no treatment is needed beyond what common prudence would suggest. When once attention is directed to the caterpillars being found on twigs of their food-trees in winter, we have the clue towards getting rid of them before they grow to the devastating powers to which they attain in spring. And when they are at work (if by unusual mishap they established themselves) their complete clearance of leafage, if the attack at all resembled in destructiveness that of which I had samples, would draw attention even in its early stages to the locality from which the great grubs could easily be removed.

In most insect attacks the best course is simply to destroy the so-called "pest" in whatever may be the simplest manner; but with such rare and exceptionally large specimens, it may be well to suggest that probably any neighbouring entomologist, or naturalist, might be willing to give some small sum for them, which would (if permitted by the owner) make it worth the while of one of the nursery workmen to collect the caterpillars and dispose of them alive.

Note.—Enquiries or observations were also sent regarding almost all the common Apple attacks, as American blight, Winter Moth, and other moths, Apple-blossom Sawfly, and Apple-blossom Weevil, Red Spider, &c. These were all duly attended to as occasion required, but having been so frequently referred to in previous Reports, it is unnecessary to repeat the details.—E. A. O.

BEANS.

Collier; Bean Aphis. *Aphis rumicis*, Linn.; *A. fabæ*, Kirby & Spence.



APHIS RUMICIS.—1, Bean shoot with Aphides; 2, male Bean Aphis, magnified; 3, nat. size; 4, wingless female, magnified.

Amongst the various kinds of Aphides which were unusually prevalent during the hot and dry season of 1898, the "Black Louse," or Aphis, of the Beans played its part in various places.

The first note of observation of its presence was sent me on the 6th of June from near Malmesbury, in Wilts, and the last on the 15th of July from the Carse of Stirling, N.B. In this case three stalks of Beans were forwarded to me* for examination as samples of a Bean attack which was then very prevalent where crops of this kind were grown on heavy land.

This kind of Aphis infestation has been so often entered on that it is scarcely worth while to allude to it again, excepting just to record it being present to a troublesome amount in some places. The appearance of Bean plants infested at the upper part, at first with a few black Aphides, as figured above, afterwards with gradually increasing numbers, until the upper part of the stalk is almost one blackened mass of the "Colliers," their exudations, and the injured pods and leafage, is generally well known, and so also *should be* the simple remedy.

By cutting off the tops early in the attack so far down as the infestation reaches, and carefully destroying these, the further spread of the mischief may be either quite stopped, or greatly checked. This cutting back does no harm as regards lessening the amount or quality of the crop; in fact, rather the other way, if it *is done in good time*. In such case it only removes just a short length of the upper part of the stem which is of very little use, whether with regard to the leafage on it, or to the pods on it, which are usually too small to be of service, and it throws the sap to the lower pods, which are benefited. If, however, the infestation has been allowed to establish itself, the above treatment would very likely be impossible. In the case of the plants (mentioned p. 5) sent me from the Carse of Stirling, it would only have saved one. The others were too far gone, from the black Aphides having spread down the stem, and also from consequent damage, both to the health and the vigour of the plant.

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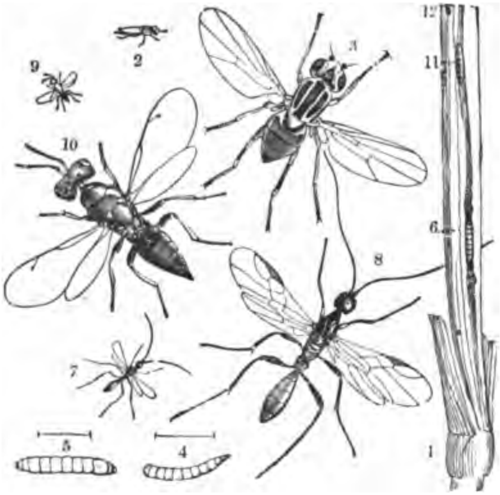
* See my reply in 'Scottish Farmer' for July 22nd, p. 567.

If the infested part is removed, this and the Aphides on it must be carefully destroyed, or many of these "Colliers" will almost certainly get back to the plants, so that new attack will be started.

In field growth there does not appear to be any remedy excepting nipping off the tops of the shoots; but in garden cultivation, good washings with soft-soap mixtures (or even with water alone), sent as hard at the infested shoots as is safely possible, so as to knock some of the plant lice off, and to clean down the leafage from the stickiness and filth, are sure to do good in this way. Also the watering helps on growth, a very important matter, as Aphides multiply most rapidly on plants which are stunted by drought or other causes.

CORN AND GRASS.

Gout Fly; Ribbon-footed Corn Fly. *Chlorops tæniopus* Meigen.



CHLOROPS TÆNIOPUS.*—Gout Fly, grub and pupa; nat. size and magnified; with infested stem. 7, 8, 9 and 10, Parasite Flies; nat. size and magnified.

* The attack is caused (as mentioned in previous Reports) by the small black and yellow fly, figured above. She lays an egg on the Barley sheath, the maggot from this attacks the ear, and then eats a channel down one side of the stem to the first knot, and then turns to chrysalis state within the leaves.

"Gout" in Barley is now so thoroughly established as one of the attacks which recur regularly to a greater or less extent every year, that it would not be worth while to notice it again save just to record some peculiarities of the infestation in coincidence with the peculiarly dry season of 1893.

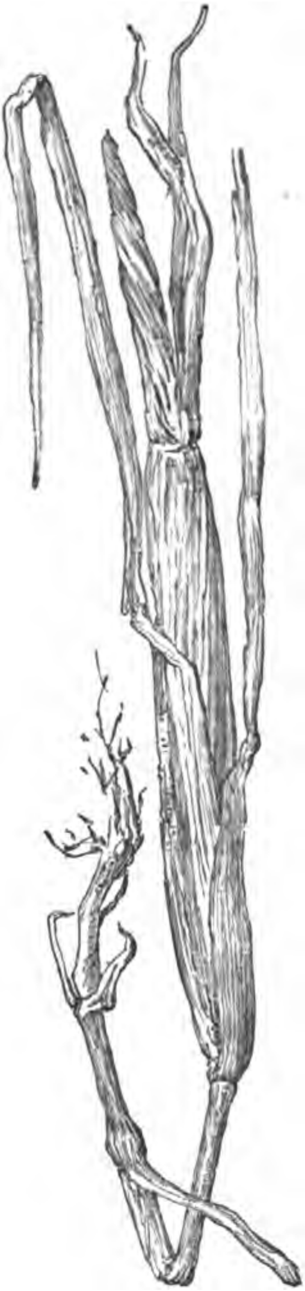
The first observation of the attack was at an unusually early date; and afterwards, during the summer, an unusually large proportion of the injured Barley was struck at such an early stage of growth that it failed to grow beyond the condition figured at p. 8. With regard to times of first appearance. Some of the earliest dates of this, of which I have had reports in previous years, were on July 9th, in 1891; on July 6th, 1889; and in the hot summer of 1887, on July 3rd. In the past summer of 1893, the first note of observation of which I am aware was on the 16th of June.

So far as has been shown by the reports sent me in previous seasons, *Chlorops* injury is a trouble of which the amount may certainly be influenced by date of sowing, and last year's observations have confirmed those previously given, that a good state of ground helps to carry infested crop over attack; and have also shown that the amount of damage may be much increased by drought and heat, which act above ground by the air being unfavourable for growth, and below ground by preventing the plant nourishment at the surface of the soil being available to the extent needed.

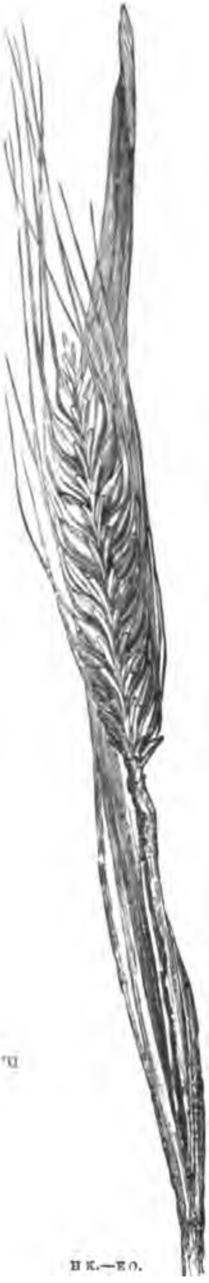
When under unfavourable circumstances the young Barley is attacked whilst the ear is still only slightly developed within the sheathing-leaves, the effect is most disastrous. The growth of the ear is ruined, and the Barley stalk, instead of running on into straw, is stopped short at a length that may be measured by inches, rather than by feet, with the sheathing-leaves in a swelled and deformed condition, of which the first figure (p. 8), taken from life by myself (see my Thirteenth Report, p. 28), gives a fair idea.

Last season, judging by the specimens sent to myself, there was a very marked presence, at least early in the summer, of this form of attack; and judging also by the observations made in the government leaflet on *Chlorops tæniopus* (the Ribbon-footed Corn Fly), published August, 1893, this peculiar form of injury was that which was mainly sent to the Board of Agriculture, as scarcely any notice is taken of what, in most years, is the most observable form of damage, in which the straw reaches a length moderately useful for farm purposes, and the ear, though injured, still produces enough good corn to make some amount of return.

The second figure (p. 8) of diseased growth shows a specimen of this most commonly observed form of injury, in which, notwithstanding the channel worked-out by the Gout Fly maggot down one side of the stalk as



Plant of Barley diseased by Gout Fly attack.



Stem of Barley showing blackened maggot-channel.

far as the highest knot, yet the ear has freed itself, and is only materially injured at the lower part. Sometimes the injury from maggot feeding may extend a third or half-way up one side of the fairly grown ear, but if the attack comes whilst the ear is still in embryo, it may extend the whole length.

In the past season the first intimation of bad attack being present that I am aware of, was given in the latter part of June by a short paragraph in several of the agricultural journals to the effect that a serious insect attack of a kind not previously observed was doing much harm to Barley in the crops of Mr. Herbert Dowsett, Park Farm, Pleshey, Essex. The first note of this, bearing date June 16th, was kindly placed in my hands by Mr. E. A. Fitch, of Brick House, near Maldon, to whom it was sent, and was conveyed in the following few words:—"Fifty acres Barley; about one-fourth is affected with maggot (as samples), which eat young ear out. Soil,—clay bottom. Neighbouring farms also affected."—(J. H. M.) The specimen of injured Barley was entirely stunted as figured, and the ear within eaten out nearly throughout its length.

On begging information from Mr. Dowsett as to details, he forwarded me ears of infested Barley, and also ears of sound Barley, standing side by side, for comparison. The injured plants showed very bad attack still in early stage. Some of the plants were stunted as figured opposite, some older, and the chrysalis stage of the maggot was already to some degree reached, for in one instance I found it lying in the upper part of the bristles or awns of the embryo ear. Mr. Dowsett mentioned that he had farmed the same land over thirty years, and had never seen any attack like it before. The Barley was all grown after fallow Mangolds and Swedes, all his own seed corn, which produced last year (1892) over nine quarters, excepting two acres after Swedes, which was sown thin with a sack of Barley bought of — *, at 10/- per bushel. Mr. Dowsett considered that a quarter of his whole crop was spoilt, and that from the bought seed was worse than the crop from his own seed corn.

Specimens of an equally bad, or even worse, attack were sent me on the 11th of July, from the Estate Office, Wendover, Tring, by Mr. Charles T. Adams, with the observation that the Barley affected was taken from a chalky soil. In this case the deformed Indian-corn-like plants, with the still sheathed ears, were sometimes hardly more than three and a half inches in length, from the ground, in the solid part, and only about six to seven inches when the leaves were laid out at full length. One of the attacked ears, when freed from the sheath, measured, when taken together with the stalk down to the uppermost

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* Name omitted for obvious reasons.—E. A. O.

knot, only just under an inch and a half in length. In this instance the attack was traceable from the top of the Barley ear down to the first knot; and the little maggot which had caused the mischief dropped from the stem on opening the sheath.

One other report it may be worth while to give as it is accompanied by notes of date of sowing, and of fresh growth from the root after rain. This was sent me on the 17th of August from The Lodge, Massington, Wansford, by Mr. H. Stokes, with the observation:—"I am sending you a few ears of Barley; . . . you will find they have been eaten by an insect from the top down to the knot below the ear, and since the showery weather it has started to grow again from the root." . . . "The Barley is taken from a 24-acre field, and appears to be affected all over; it is after a root crop fed off by sheep, and drilled with the Barley on the 18th, 19th, and 20th of April." These specimens also showed *Chlorops* injury.

In the case of a *Chlorops* attack on Barley, of which specimens were sent me at the end of July, by Mr. Thomas Bunker, of Goole, Yorks, the loss by the attack in the field, from which the insect-blasted ears were sent, was estimated by the farmer to be one-third of the crop.

The following communication with which I was favoured by Mr. J. J. Willis, on the 16th of September, from Harpenden, Herts, is of such important interest relatively to good effect of properly selected manure in lessening effect of infestation, that I offer it with many thanks for the reliable observations:—"You may be interested in the following particulars. During the present season much injury was done in this neighbourhood to the growing crops of Barley by the Gout Fly (*Chlorops tæniopus*). The Barley experiments of Sir J. B. Lawes, at Rothamsted, also suffered greatly from the same cause; but it is a fact of much interest that the infestation was considerably worse on those plots which were deficiently manured, while on those plots which were fully manured, that is, received all the necessary constituents for healthy and vigorous plant growth, the injury done was insignificant."

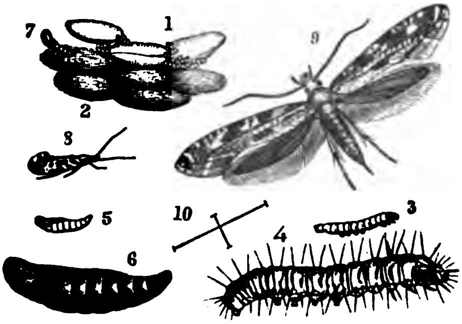
Prevention and Remedies.—One very special point of information to be learnt from the past season's observations, is the great degree to which the effect of this kind of attack is influenced by age or condition of the plant, or state of its surroundings. In most kinds of insect attacks it is leaf, or root, or flower, or seed, or it may be attack to the outside of the stem, or inside of the timber; and though infestation may in any of these cases be fatal to hopes of a crop, still there is a good chance of some return. With *Chlorops* attack it is different. This comes on the very centre of growth, and if the plant is still young, it ruins both the ear and the straw. Later on, as the point of deposit of egg is the sheath of the ear, we may save a fair amount of straw, and this and the embryo ear being then grown to a fair size, the infestation cannot do so much harm. The work of a single maggot towards the base of a half developed, or nearly developed ear, and a channel down one side of a fairly grown stem below it, is then very different in effect to that when the length of the whole portion (ear and upper joint together) are scarcely six times as long as the destroying grub. If the reader will note the measure of one of the specimens (one and a half inch) sent me by Mr. Adams, when the ear was freed from the sheath, and compare this length with that of the grub (three-eighths of an inch) figured at p. 6, he will see that this is no exaggeration.

It is of very practical use to bear this in mind, for here we have the key to the benefit of early sowing so well brought forward by Prof. McCracken, at Cirencester, where the March sown Barley was practically free from attack, whilst that sown in May suffered to an extent of not less than twenty per cent. (see my 'Manual,' p. 78), and the same point has been noted by various other observers.

Good growth and a good early start are two things specially wanted to carry on the plant successfully, and though it may be said we cannot command the seasons, still Mr. Willis's note, p. 10, shows that even in the past bad season, and in parallel circumstances of fly being about, the deficiently manured plots were those that suffered most.

This is one of our very worst and most regularly recurring corn crop attacks, and so far as we see at present, agricultural measures are the only reasonable means we have of dealing with it. The winter brood may very likely be in various grasses, &c., and the flies may hybernate here or there; but at present we have not been able to utilize these more theoretical points.

Little Grain Moth or Wolf Moth. *Tinea granella*, Linn.



TINEA GRANELLA.—Little Grain Moth, flying, magnified, lines showing nat. size; moth at rest; caterpillar and chrysalis, nat. size and magnified; infested corn-grains spun together.

In the course of the autumn, Mr. Edward A. Atmore, F.E.S., writing to me from King's Lynn, Norfolk, mentioned the enormous numbers of the *Tinea granella* (popularly known as the Little Grain Moth or Wolf Moth) which had appeared there in the course of the summer. This infestation has long been known as seriously hurtful to stored corn; and its history, and preventive measures regarding this part of the mischief it causes, have been most fully written on by some of our best British and European economic entomologists, from nearly the beginning of the present century up to within two or three years of the present time. In the later of these observations, however, attention has been more fully directed to the extent to which this infestation may be found in natural circumstances in out-of-doors localities, as well as in its artificial and chief head-quarters of stored corn; and in the past season, enquiry was sent to myself as to the nature of attack to the inside of ripe corn-grains still in the ear, which might, I think (if further followed up), prove to be due to the larvæ or caterpillars of this Little Grain Moth.

The note sent me on the 4th of October by Mr. E. A. Atmore, from King's Lynn, was as follows:—"*Tinea granella* simply appeared in swarms in granaries about the town. I have never before seen anything like such numbers of any one species of moth in my experience. When these swarms emerged it was almost impossible for the men to work in the granaries. The stored grain must have suffered from the attack."

Mr. Atmore being an experienced entomological observer, his note of this unexampled appearance is of very practical value, and it may be of use to give some of the main points of this grain infestation for reference, in case it should be remarkably present again in the coming year, and also as a help for observation of maggot attack within grain, before carrying the sheaves.

The *Tinea granella*, or Little Grain Moth, is about half to two-thirds of an inch in spread of the fore wings; these are somewhat narrow, white, and marked with many brown spots, of which characteristically six or seven lie along the fore edge of the wing, three of the largest of these being respectively one at the base of the wing, and two others before and beyond the middle. The fringes are brown varied with white. The hinder wings are also narrow, and are of a mouse or greyish colour with pale grey fringes. The moths may be found from April to August.

In granaries or corn-stores the method of attack is for the moth to lay one or two of her very small yellowish white eggs on a grain of corn. How many she has a capacity for laying is still uncertain. In the words of Dr. Ritzema Bos, "Whilst according to Nordlinger the number only amounts to thirty, Taschenberg speaks of it as being more than one hundred." After about fourteen days (it may be more or less) the maggots hatch. These make their way into the corn-grains, and there they feed, till, provision falling short, each grub makes its way out again, spins another grain to the one from which it came, and when the contents of this second grain have been devoured it proceeds in like manner to another, so continuing until as many as twenty or thirty grains have been emptied and spun together into a mass, mixed with web and maggot-dirt, as shown at "2" in figure at p. 11.

The caterpillars are sixteen-footed; that is, have three pairs of claw-feet, four pairs of sucker-feet beneath the body, and another pair at the tail; when full-grown they are rather under half an inch in length; the general colour pale ochrey; the head horny and brownish red, and on the back of the next segment there are dark transverse marks interrupted in the middle.

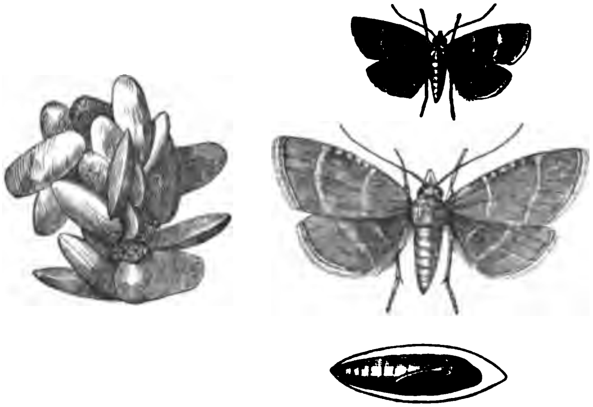
When these larvæ or maggots are nearly full-grown, they have the habit of not remaining in their feeding quarters, but, leaving the inside of the grains, they pass to and fro, "run about in numbers," as it is expressed, on the surface of the corn, spinning their threads until the whole surface is covered with a thick whitish grey web. When full-grown, which commonly is in August or September, they leave the corn, and betake themselves to any convenient shelter in crannies in the floor, or roof of the granaries, or chinks in the wall. There each caterpillar spins a cocoon of web, or, if circumstances permit, of web mixed with little bits of wood gnawed from its surroundings. Here the larva remains unchanged during the cold weather; it then assumes the chrysalis state, from which the moth may come out, according to circumstances, in March, April, or May.

The above gives just a general sketch of the ordinarily recorded life of this infestation in granaries, without reference to possibilities of second broods, or of effects of variations of temperature; and the recorded remedies turn, to a great degree, on the obvious points of preventing, as far as possible, presence of sheltering places for the larval winter rest, by plastering or filling up all nooks in walls and floors, &c., where cocoons could be spun, and similar measures. Also on careful cleaning, whitewashing, scalding, &c., where granaries are, or may be, infested, before putting in new corn. And to these I would add a note, from my own observation, of the effectiveness, in cases of this kind, where steam power is at hand, of turning on a jet of scalding steam or scalding water by a hose from the engine. Where this can be done the effect in destroying maggot or insect presence is excellent. More elaborate operations, as destroying maggots in the corn itself by applying heat which will not injure the corn for use, though destroying its power of germination,—or, on the other hand, of checking maggot growth by currents of cold air through the heaps of corn,—are detailed at length by various writers, and can be referred to if needed.

But beyond the well-known damage to stored corn, there is what may be happening to ripe corn in the fields, which hitherto has not been investigated as much as might be desirable. Dr. Taschenberg notes of this species, that all kinds of corn are similarly acceptable to it, and that it will on occasion attack other material, as dry fruits or woody fungi. And again, in another passage he notes, after observations on the habits of this *T. granella* in corn stores, that outside, in the open air (or rather in free circumstances), the eggs are in other conditions; they may be laid in the previously mentioned fungi; likewise in grass-seeds, which are always present. It is also noted by Curtis, in 'Farm Insects,' and by Hammerschmidt in Kollar's 'Insects,' that this species of moth deposits its eggs on corn in the field, or in corn in sheaves in the field.*

For lessening danger of this occurring, the obvious plan is suggested of not letting the ripe corn stand uncut longer than is necessary, and also similarly treating the sheaves. It would be of interest to find whether in the coming season, with attention drawn to the subject, it will be observed that damage, in the form of hollowing out contents of ripe corn-grains in the field, occurs to an important extent.

"**Hay-stack Moth.**" *Pyralis glaucinalis*, Linn.



PYRALIS GLAUCINALIS.—Stack Moth, nat. size and magnified; cluster of chrysalis cocoons, giving side and edge view; cocoon opened, showing chrysalis within, magnified.

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* Information on this attack will be found in the old standard authorities of Curtis' 'Farm Insects' and Kollar's 'Injurious Insects,' revised by Prof. Westwood; and more recently in the 'Praktische Insekten Kunde' of Dr. E. L. Taschenberg also (bringing the subject up to the recent date of 1891) in the 'Tierische Schadlinge und Nutzlinge' of Dr. J. Ritzema Bos.

The following note of presence of infestation of the little *Pyralis* moth (figured p. 14) in the outer part of some fodder stacks, especially Clover and Saintfoin, near Canterbury, is given, because, though it has not been reported as doing much mischief, yet where the white cocoons of the chrysalis occur to any noticeable amount, a scare sometimes arises as to the quality of the hay being injured.

Whether there is reason for this does not appear, but, in Canada and also in many of the United States,* much harm is at times caused to Clover-hay, which has stood for some years, by infestation of the caterpillar of a very nearly-allied species of *Pyralis* moth, which is sometimes taken here (that is, in England) round stacks, and which is scientifically known as the *Pyralis* or *Asopia costalis*, more popularly as the "Gold-fringe." In America it is popularly known as the Clover-hay Moth or Worm; therefore, as our *P. glaucinalis* appears to be at present without a convenient appellation for common use, I have ventured to suggest the above term of "Hay-stack Moth," as indicating one of its most important localities.

On the 7th of June, Mr. W. Gardner, writing from Bekesbourne, near Canterbury, forwarded me some bunches of the white, flattish-oval cocoons of these moths, spun up with rubbish of the dry material amongst which the caterpillars had fed, and the observation:—"I took them from the outsides of a Saintfoin-stack that has been standing here three years. I never remember to have seen anything of the kind before, and when we cut the stack out, which will I hope be shortly, I shall look and see if it is only on the outside they are very numerous."

The cocoons, of which a good many were successively sent me by Mr. Gardner, were pure white, of a filmy material, like rather flocculent silver paper, and transparent enough to show the shape of the contents when held against the light. The individual cocoons were in shape much like a melon or gourd-seed (see figure), about half an inch in length, rather less than a quarter of an inch in breadth, and rather more than an eighth of an inch in thickness. The two convex sides met, like a melon-seed, at an obtuse edge, and at the extremities were bluntly rounded; one end remained unaltered, the other split open from side to side (to allow the exit of the moth), with such a perfectly straight separation that it seemed doubtful whether this part had been more than just lightly closed. At first the cocoons were very perfect in form, and pure in whitness; with the escape of the moth they sunk in irregularly.

The contained chrysalids were of a chestnut-brown colour and about half the width of the cocoon, and one-sixteenth of an inch less in length, and, as far as I saw, lay with the tail extremity either fastened to the inside of one end of the cocoon or quite close to it, the spare space being at the head end. Some of the cocoons lay separately, but for the most part they were spun into clusters by admixture of much caterpillar-web, together with caterpillar-dirt, bits of stick, or leaf, or flower of the material of the stack, and small rubbish generally.

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* See paper on "Insects Injurious to Clover," by Prof. William Saunders, in Annual Report of the Entomological Society of Ontario, for 1881, p. 45.

The first moth appeared (out of cocoons sent me) on or about June 7th, and other specimens appeared from small consignments of cocoons sent me by Mr. Gardner for several weeks. These moths (the *Pyralis glaucinalis*) are from a little under to a little over an inch in the spread of the fore wings, which are shiny, and pale grey or grey brown, somewhat browner towards the fore edge (the *costa*), which has a distinctly reddish tinge. Two yellowish lines or slender bands cross the wings transversely from back to front, so as to divide them into three nearly equal portions; and between the extremities of these, at the fore edge of the wing, the reddish colour of the *costa* is very prettily alternated with a few buff spots. The hind wings are also greyish, with two pale cross lines; and round the extremity of each of the four wings, just inside the fringes, there is a faint line, sometimes scarcely observable.

On the 20th of July, that is, about six weeks after Mr. Gardner forwarded me the first specimens, he wrote again concerning this stack infestation:—"I enclose a few more of the odd-looking cases, which appear to me to have some chrysalids in them, which I found around a stack of second-cut Clover growth of 1891. The other stack is now being cut out, and the old 'trusser' says he has seen them before, and they do not go in far from the outside, and (although one hay-merchant who saw them said they would eat the Saintfoin, and he would not have the stack at any price), this old man, who has bought the stack, has made no fuss about it." On the 28th July Mr. Gardner, sending me at my request a further supply of the cocoons, wrote accompanying:—"I have to-day collected the enclosed, which I hope you will find useful. I found them in every one of the stacks, excepting this year's, and even in this year's I started a moth, but they seemed to have preferred the Clover and Saintfoin, as there were very few in the old haystack; they seem to prefer it where it is looser; I suppose it is easier to get further in, and they were apparently more on the N.E. and N.W. sides of the stack."

A little later (on the 10th of August) Mr. Gardner wrote:—"I have been to the stack two or three times since, and find the moths are still coming out, but they do not seem nearly so numerous. They frequent the upper part of the stack more than below I suppose because they find penetration easier; in the old haystack, which is very close, there are very few indeed, I might almost say *nil*. They put me very much in mind of the clothes' moths, as they seem to run into the stack again as soon as they settle after flying out. They do not appear to go in to any great distance, I should say from six to nine inches, according to the closeness of the stack."—(W. G.)

The above observations of Mr. Gardner show this moth infestation to occur in the outside of various kinds of fodder stacks, as of Clover, Saintfoin, and hay, but to be most prevalent in the material which is most open to ingress, and also in the upper part of the stack, which is the least closely pressed together. The date of successive appearances of the moths ranged over at least nine weeks, probably more, as in the first little packet of cocoons sent me on June 7th there were some containing only empty chrysalids, besides one moth which appeared to have developed during transit; and up to August 10th moths were still observed by Mr. Gardner to be continuing to appear.

As when first the infestation was sent me I was unacquainted with it, I forwarded specimens to Mr. S. L. Mosley, Huddersfield, who gave me the name; and I am also indebted to Mr. Porritt, of Huddersfield, for the observation that "the larva feeds on all kinds of dried vegetable matter, and that he has frequently beaten the moth out of thatch."

In some communication on the subject with Mr. Edward A. Atmore, F.E.S., of King's Lynn, Norfolk, he wrote:—"With regard to the *Pyralis*, it breeds here in accumulated rubbish formed on Birches from the adventitious buds, which produce those peculiar bird's-nest-like formations. I have bred moths from them, but the insect does not seem to be common here."

In an early number of 'The Entomologist's Monthly Magazine,' * there is some very good information by the late William Buckler regarding the appearance of the larvæ of this moth; and also some interesting detailed observations by the Hon. T. de Grey (now Lord Walsingham) on this infestation being found in the masses of deformed twigs often found on Birch trees. †

The larva of the *Pyralis glaucinalis* is thus described by Mr. Wm. Buckler ‡ (see previous reference to Ent. Mo. Mag.):—"At this date" (the 18th of April, 1869) "the youngest larva was about half an inch long, of a dull pale brownish olive green; others were larger and darker, the colour darkening with the growth, until the full-grown larva was almost black.

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* See 'Entomologist's Monthly Magazine,' vol. vi (1869—1870), p. 111.

† These masses are sometimes known as Witch-knots, or Witches'-brooms, and are caused by a Gall Mite, or four-legged *Acarus*, one of the Phytoptidæ, nearly-allied to the Black Currant Gall Mite, the *Phytoptus ribis*, which causes the swollen growth of buds only too well known to bush fruit-growers.

‡ Mr. W. Buckler's description of the larvæ is given in order to complete the life-history, as I had not the opportunity of observing the insects before they had spun up, and were beginning to emerge in moth condition.

"When full-grown the length is from $1\frac{1}{12}$ to $1\frac{1}{8}$ inch; the form moderately slender, cylindrical, nearly uniform in bulk throughout, the hinder segments tapering a little at the sides; the region of the spiracles puffed and wrinkled; the segmental divisions deeply cut. The colour of the back is a blackish bronzy green, becoming paler, of an olive or ochreous green tint along the spiracles, and on the belly and legs, the head, and the second and thirteenth segments; the plate on the second segment is margined in front with blackish olive; a fine blackish undulating line, apparently caused by a deep wrinkle, runs along below the spiracles which are inconspicuous, being of the surrounding colour, and merely outlined with blackish; the tubercular dots are a little raised, each bearing a fine hair, the whole surface is shining and bronzy-looking. The first mature larva spun its cocoon on the 23rd of April."—(W. Buckler.)

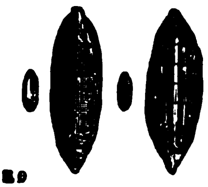
The descriptions of the cocoons (so far as given by both the above-named observers) exactly agreed with those from the various kinds of hay or fodder stacks from out of which I developed specimens of the *Pyralis glaucinalis*, and the surroundings of the infestation, whether in stacks, or thatch, or Birch-knots, is much of one kind. That is, dead vegetable matter, passed on in some cases to the next stage of decay, and a point noticed by Mr. Buckler, in his paper above quoted, "of the larvæ being found in the Birch-knots amongst many old cocoons and pupa-cases"; and the observation of Mr. Gardner of the moths hastening back into the shelter of the stack when disturbed, point to the colony when once established remaining continuously, if allowed, in the same spot.

PREVENTION AND REMEDIES.—No complaint of loss from this infestation has been made, though certainly it cannot be desirable to have any appreciable quantity of the hay mixed up with cocoons and old insect rubbish and caterpillar-dirt. But in the case of our nearly-allied British moth the "Gold-fringe" Pyralis, which is now widely distributed in North America, the very similar but greater damage caused *there* is well established, and has to be guarded against, and the same method would be serviceable here.

As there it is towards the lower part of the stack that the greatest damage is done, and sometimes "two feet or more of the lower portion has been so full of worms as to be rendered worthless," it is pointed out that "where Clover is stacked for several years on the same foundation, the bottom layers coming in contact with the infested leavings of the previous year, will be sure to suffer. It is also recommended to put a good log or rail foundation under the stack so as to raise it above the surface."—(W. S.)

From the various observations of our own *Pyralis*, Stack Moth, it is shown that attack may continue when once established in a suitable locality of dead fodder, sticks, or rubbish; and if the infestation occurs to a troublesome amount it would be desirable, besides clearing out all head-quarters such as may be furnished by rubbish beneath the stack, to give attention to similar neighbouring surroundings. Caterpillars that feed amongst masses of old Birch twigs, or in thatch, as well as in old stacks of Clover, hay, or Saintfoin, cannot be very exclusive in their diet, and by care in search, and also in destroying all spoilt outside of the stacks which might prove to be infested when opened, we might save all further attack.

Hessian Fly. *Cecidomyia destructor*, Say.



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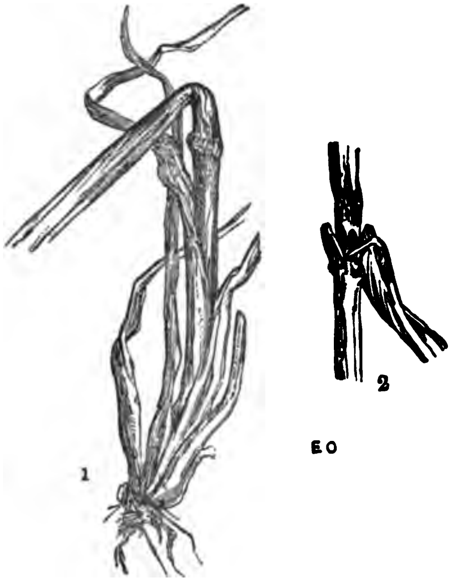

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CECIDOMYIA DESTRUCTOR.—1, Barley stem elbowed down by Hessian Fly attack; 2, showing position of "flax-seeds." Also flax-seeds, or puparia, nat. size and magnified, showing the early and smooth, and the later, or striated, condition.

Hessian Fly attack appeared in some localities in the past year; but, personally, I had so very few applications on the subject, that altogether these can hardly have amounted to a dozen notices at the very outside. Also a few apparently reliable accounts of presence of this infestation in various districts appeared in various of our agricultural journals; but I cannot myself see any cause for great anxiety on this matter any more than with regard to others of our ordinary corn insect pests. Last year being a hot season, especially favourable to its prevalence, it was to be presumed it would be present; but so far as I am aware, this was not to anything like the extent to which it was reported in the hot season of 1887. In that year, the second of its recorded presence as a Wheat and Barley stem pest with us, it was reported (with specimens accompanying, or by contributors well conversant with the attack) from more than seventy-two localities in England, and about twenty in Scotland, these centres often representing districts, and sometimes many miles of area of attack; as for instance, in the north of Scotland, whence on the 29th of August, Mr. John Milne, of Inverurie, Aberdeenshire, wrote me (with specimens accompanying) that traces of the insect could be found in every field along the coast from Aberdeen to Cromarty, and inland for twenty-five to thirty miles.

Yet, notwithstanding this widespread prevalence in 1887, in the following year I only received about six reports of presence, and of these only one mentioned the attack as being prevalent in that district; and last year attack generally seemed hardly worth alluding to.

The infestation may commonly be known by the attacked Barley or Wheat straw elbowing down (as figured at p. 19) just above one of the lower knots in the stem, consequently on this part being weakened by the continuous feeding of the little maggot of the brown gnat midge, known as the Hessian Fly. Attack may be higher, or it may be lower, even at ground-level. Where it is may be known on examination by the presence of the little flat brown chrysalids known as flax-seeds, figured p. 19 at "2."

It is a most unlikely thing that this infestation will ever take hold here with our insular and changeable climate, as it does in Continental countries, where a recurrence of weather suitable to its propagation may come more or less yearly as a matter of course; and it is to be regretted that from some cause or other a popular and exaggerated interest has become attached to the very mention of "Hessian Fly"! I fully believe that, excepting Corn Sawfly, we have no corn attack which it so fully lies in our power to check increase of; or I should better say, no corn attack which can be so demonstrably, and even arithmetically, proved to lie so fully in our power to check much of the increase of.

On each farm where there has been Hessian Fly attack, we find at thrashing time the chrysalids gathered up, without extra cost or trouble, in the light screenings. If these are destroyed in any convenient way there is an end of all increase from these.

If, on the other hand, these flax-seeds are only flung aside from neglect, or saved for any reason whatsoever, it is a certain thing that, weather and circumstances permitting, the Hessian Flies from them will attack next year's crop; if destroyed there will be no further trouble from them.

Where circumstances do not allow the winter crop (as after infested Barley) to be ploughed in, or otherwise treated, so as to destroy the flax-seeds fallen from the stem, we have no apparent remedy, and we must in this case hope that the "parasites," which are so frequently brought under our notice, and which really do good in destroying the pest when we are not able to do it (as above mentioned) much more surely ourselves, will play their part rightly.

Where flax-seeds have fallen, as many must, amongst the stubble of the reaped cornfields where the plough is to be put in, the matter, if requiring attention at all, can be met to some extent by treatment. Deep ploughing, or ploughing with skim-coulter, so as to turn the flax-seeds thoroughly down where they will not be brought up again by subsequent agricultural arrangements, will quite certainly be useful.

Also burning the stubble is a well proved remedy, and would get rid of many kinds of insect pests besides the one under consideration. In most seasons this operation is neither very easily practicable nor much needed, but last season (1893), when the exceptional heat and drought would have allowed the firing, it would have cleared out the ground remains of attack excellently. The right method of operation is first to burn a narrow band of stubble all round the field, this effectually keeps the fire in the circumscribed area, and ensures safety to hedges. In the opportunity of observation given by railway journey, I have noticed fields and strips of fields safely fired, and the benefit in clearing pests that we can get at no other way is great.

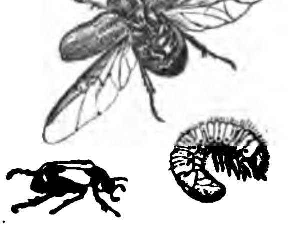
But in our island we have great security from prevalence of serious widespread attack, in our climate, and so far as Wheat is concerned in our customary date of sowing, bringing up the autumn Wheat after the time of the autumn brood of Hessian Flies having died off; and if in the coming season we have ordinary climatal conditions, it may reasonably be hoped that widespread mischief will be as little present with us from this pest as in the years after the hot season of 1887 to the hot season of 1893, when though bad in some localities, it could not be described as a general trouble.

Whilst the above note on Hessian Fly was passing through the press, I was favoured by Mr. W. M. Schöyen, Conservator and Government Entomologist at the Zoological Museum, University, Christiania, with the following observation of the first recorded appearance of this pest, the *Cecidomyia destructor*, in Norway. With the notes of locality, &c., given below, Mr. Schöyen also placed in my hands a few specimens of Barley stems with the puparia of the Hessian Fly, commonly known in this country as flax-seeds, still adhering to the stem beneath the sheathing-leaves.

Mr. Schöyen's communication, sent from the Zool. Mus., Univ., Christiania, on the 19th of Oct., was as follows:—"I hope that it will be of some interest for you to know that the 'Hessian Fly' (*Cecidomyia destructor*) is now, for the first time, observed here in Norway doing damage upon Barley. I send you herewith some small bits of Barley stems with the 'flax-seeds,' or puparia, of this insect that you may ascertain the fact. As I am told, the damage on the concerned locality, Ringerike, was last year much greater than this summer, at least one-quarter of all the Barley stems having then been 'elbowed' down by the insect; but then I knew nothing of the matter. Having been informed this summer of the presence of some noxious insect in the Barley stems on the named locality, I visited the place in the middle of August, and found some of the maggots and puparia of the Hessian Fly between the sheaths and stems of the damaged Barley plants. It is thus made evident that this noxious insect is now introduced even to our country, probably with foreign seed corn; though I hope this insect will not prove so fatal to us as in more southern countries. Preliminarily I have recommended the burning of the infested screenings and fall-ploughing of the land instantly after harvesting."—(W. M. S.)

Under the careful attention which is being given, there is good hope of the recurrence of the infestation to a severe extent being well held in check.

Rose Chafer; May-bug. *Phyllopertha horticola*, Linn.; *Anisoplia horticola*, Curtis. **Common Cockchafer.** *Melolontha vulgaris*, Fab.*



PHYLLOPERTHA HORTICOLA.—Rose Chafer, nat. size (walking), magnified (flying); grub, also magnified.

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* A few notes having been sent of presence of Cockchafer grubs at a locality also infested by those of Rose Chafer, the observation is added in the following paper.

Rose Chafers have caused serious mischief in a good many localities during the past season. As a common thing (that is, in ordinary seasons and excepting under very special circumstances, or just here and there) no great attention is paid to the pretty brown and green beetles which, however destructive to Roses for a while, pass away presently, and unless they have extended their ravages to leafage, or much more widely than is customary, are little more thought of. Also they are known, but by few, to be the parents of the grubs, like little Cockchafer grubs, that presently ruin the adjacent lawns and meadows by preying on the roots of the Grass. Last season, however, Rose Chafer presence, both in beetle and maggot state, was too great, and too marked, to escape observation, and the notes contributed may help to a better understanding of the nature of the attack.

Amongst points which have been especially noticed in the following observations are,—firstly, the continuance of this Rose Chafer infestation for year after year in one locality when thoroughly established. Secondly, that when the swarms of these pretty brown and green Chafers appear at their work of destruction, whether on Roses or elsewhere, unless means are taken to destroy them, their disappearance in the natural course of things will be followed by an autumn appearance of grubs (see figure, p. 22) in Grass-fields, lawns, and the like places, which may prove possibly only disfiguring from the patchy condition of the field where Grass has died from attack at the root, or possibly may be on a scale making new laying down of the field requisite. Where grubs are in the numbers named at page 25, of twenty-one grubs or somewhat more to a foot square of ground, this would be somewhere about one grub to every two and a half inches of Grass roots, and the results are necessarily serious. Thirdly, that whilst the beetles are on Roses or leafage from which they can be shaken down, a great deal may be done to get rid of the infestation surely, cheaply, and easily; but when the grubs are at work at the roots of the Grass, I should certainly say myself, judging by what information I can gather, that to destroy them without greatly injuring or destroying the Grass is a matter well nigh impossible, even with the assistance of the flocks of different kinds of birds, which do their best to aid us in clearing the pests.

One of the first notices which I received during the past season of the Rose Chafers being observable in great numbers, was sent me on the 23rd of May, from Foxbury, near Sevenoaks, Kent, with specimens accompanying, by Miss Matthews, who wrote as follows:—"I am desired by my brother to forward to you a few specimens of an insect which has been found here in immense numbers during the summer months of the last two years, and is now on the lawns, meadows, and fruit plantations of his property in greater numbers than before. The insects devour Roses, but so far we have not *noticed* that they eat other leaves. They swarm out in the sunshine, but disappear within the cups of flowers, or holes in the Grass, directly the sun is obscured, or the weather becomes dull and cool. My brother is a grower of Hops, Nuts, Plums, and Currants; and the soil being very sandy and poor, a very liberal use of manures is necessary for their successful cultivation."

The specimens sent me were of the little bright brown and green Rose Chafers, the *Phyllopertha horticola.* These I found to be wonderfully active in the earlier part of the day. In the evening they were quiet and torpid, but when set on the window-sill, they roused up and walked to the edge, and then (with one exception) spread their wings and flew strongly away.

The infestation was exceedingly prevalent near Haslemere, in Surrey; and the following note, with which I was favoured by Mr. Charles Pratt, of Marley, near Shottermill, Haslemere, gives a very good observation of it in that locality:—"The Chafer which has been so destructive in my pastures and lawns, and other crops, is the bright copper-coloured creature, with blue-green head, called (Mr. Buckton tells me) *Phyllopertha horticola.* It did not attack the corn crops, but infested Roses and many garden things. The grubs have eaten the roots of the Grass which has decayed, and on being pulled comes off in large patches. Thousands of starlings are at work in the pasture fields pulling up the dead Grass, and turning it off to get at the fat succulent grubs, and the thrushes are doing the same good work upon the lawns." . . . "What I propose to do is this: to harrow up with a long spiked implement all the decayed turf, and leave the Grass exposed to the further attention of the birds for a week or two. Then sow renovating seeds over the bare places, covered with freshly dug sand (my natural soil), and well roll it. The autumn rains will, I hope, bring up the seeds before the frost sets in. Then I shall apply a heavy dressing of lime all over, and leave it till the spring, at which season, if it looks promising, I shall give a top-dressing of artificial manure (of a sort to be decided upon), and trust to getting a little Grass for next year's hay and pasturage."

In a second letter on the subject, written by Mr. Chas. Pratt, on Sept. 22nd, he mentioned:—"For the thirty years during which I have had experience with land, I have had no knowledge of any insect pest so destructive as this *Phyllopertha* Chafer. But I live on a sandy hill, and I never knew such a drought before!" . . . "I stated that it had not infested my cornfields; but the result of more complete investigation to-day convinces me that my statement was premature. The grubs are found in a lively condition about eight inches below the surface in the corn stubbles. I doubt now whether any remedy will extirpate them that can be economically applied." . . . "I have a number of chickens and guinea fowls feasting on the grubs, and I shall turn out a few pigs, as you suggest, and see what they will do. But I find that these grubs can go down very deep in my light soil. I am sending you a box containing some of the grubs, packed in a small piece of the destroyed pasture in which they were found, and it will give you some idea of the number of them when I state that all that are contained in this little box were found near the surface on a space one foot square." (These amounted to upwards of twenty-one grubs. —E. A. O.)

For the following note of great presence of the Rose Chafers having occurred for a few days, and of the simple method used to get rid of them, I am indebted to Mr. T. P. Newman, of Hazelhurst, Haslemere. Writing on the 20th of September, Mr. Newman mentioned:—"They swarmed with me for two or three days only; we did nothing by day, but acted on your hint at dusk; put sheets under the fruit trees, shook the latter, and picked up hundreds of the beetles, which made no attempt to escape, and destroyed them in hot water. They attack the Scotch and Austrian briers much more than any other Roses."

Specimens of the same kind of Chafer grub, and at the same stage of growth as those which were then being forwarded from various localities as doing great mischief to Grass where the Rose Chafers had appeared earlier in the season, were sent me on the 28th of September by Mr. C. R. Longbourne, of Ripsley, Liphook, Hants. Amongst various points of interest it will be seen that date is given of the first observation of damage being established to an amount sufficient to attract birds to the grubs in the injured turf.

Mr. Longbourne mentioned:—"At the suggestion of my neighbour, Mr. Newman, I am forwarding in a small box some specimens of grubs taken from the meadow near my house; it is suggested that they are the product of the small brown beetle which appears yearly on our lawns and fields in the month of June, and which this summer swarmed in unusual quantities. The grubs this season have done considerable damage to some fields and lawns in this neighbourhood. They eat the roots of the Grass, which therefore withers and comes away in patches when touched. Large flocks of starlings, numbering several hundreds in a flock, frequent the fields where these grubs abound, and the soil is perforated by the birds' beaks. In the field in front of my house my fowls are constantly hunting after the grubs, and, by their scratching, they have made large patches of it look like a ploughed field, the Grass plant coming away in tufts, as before mentioned. I should state that our soil is a poor sand, and that, in the fields in question, the plant of Grass is very inferior. P.S.—Judging from the work of my fowls, I should say the grubs first appeared near the surface about the middle of August, but it was not until the 2nd of September that my gardener brought me some specimens to show me the cause of the havoc wrought by the fowls, and of which I had been complaining."

On Oct. 12th. Mr. Longbourne further wrote:—"I have seen less of the grubs since the recent rains, and they have probably gone down deeper into the soil."

Maresfield Park, near Uckfield, in Sussex, was another of the localities at which the presence of the beetle in great numbers early in the season was followed by presence of the grubs beneath the turf in autumn. On May 25th, Mr. Mark Sandford, writing from the Estate Office, Maresfield Park, remarked:—"This year we have a plague of beetles, some enclosed herewith" (these proved to be specimens of the Rose Chafer, the *Phyllopertha horticola*); "they eat up our Roses, and are in shoals on the Grass of the Park here."

On Oct. 2nd, Mr. Sandford, in reply to my enquiry whether the beetle larva were to be found in the ground on which the Rose Chafers had been noticeable, further mentioned:—"We have just been searching in the turf in the park at places where the turf is dug up by the rooks, and find grubs which I think you want. I have often wondered what the rooks were searching for, and now I suppose we know; I send you some by this post. For years we have found the rooks doing this, generally in one portion of the park. The bailiff searched other places not touched by the rooks, and could find no grubs."

Another communication, also showing the prevalence of the infestation in the neighbourhood of Haslemere, was sent me on the 19th of September, from Longdene, by Mr. Wm. Jackson, as just a short note pending possible fuller observations:—"At present we only suffer from a slight disfigurement of our lawns, and from an uneasy feeling that the worst is yet to follow, and is unknown. The birds are doing good service in removing the grubs, but they do not do so very tidily."

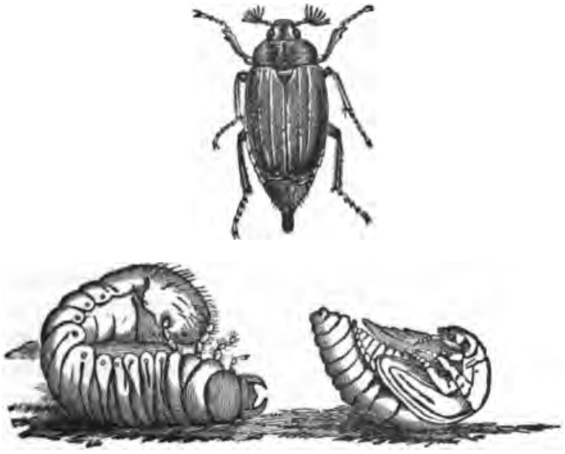
Near Rickmansworth (through favour of a friend), I heard of severe presence of this same infestation at Grass roots in one locality, the ground being exceedingly infested with the grubs, of which samples were sent me, notwithstanding crowds of birds of all kinds which were to be seen greedily feeding all day.

Other observations, which were of unusual interest, inasmuch as they referred to presence of the same kind of grubs as those previously mentioned a little below the surface, and the grubs of the Cockchafer (the *Melolontha vulgaris*) deeper down, were sent me from Detmore, near Cheltenham, by Miss Dobell.

The first of these was sent me on the 4th of September, and noted that on the previous day, September 3rd, one of their fields of six acres was observed to be infested in large patches by Cockchafer grubs. These were in colonies under the Grass, which was dying off, and in places had been much torn up by the fowls during the previous day or two, and thus attention was called to the state of things. The fowls were stated to be doing their best, but their plan of operation to be so destructive, that a remedy was desired which might be equally effectual without ruining the pasture.

A few days later, Miss Dobell further wrote:—"Before your letter came I had set some men and boys to work to gather them, and we have had thousands, and still have more to do. You can put your hand under the Grass and lift the Grass off, and wherever you can do this there are the grubs. We are burning the Grass as we take it off, as even in this short time (since haymaking) the Grass has died too much to be worth planting."

Specimens of the grubs which were forwarded to me showed that some which were dug up about a spade depth were certainly Cockchafer grubs (scientifically, larvæ of the *Melolontha vulgaris*); others taken from immediately below the Grass appeared in no way to differ from the grubs of the Rose Chafer.



MELOLONTHA VULGARIS.—Common Cockchafer, larva, and chrysalis.

On the 27th of September, Miss Dobell further mentioned:—"In all the places where we have not picked the grubs, they still remain just below the Grass. I thought the three frosts we have had might kill them, or send them deeper, but it has not. We have left off taking them, and left the birds and chickens to do what they can; but though they have been hard at it, I am sorry to find they leave many behind where they have been." And two days after, on the 29th, the grubs were as active as ever, or more so. The length of the Rose Chafer grubs when extended, which I had not previously measured, was now a little under three-quarters of an inch; and Miss Dobell noted,—"Now the rain has come they seem very active, and the birds too; our field is at times black with starlings and missel thrushes."

The mischief caused by the feeding of the Rose Chafer grubs beneath the turf continued certainly up to the middle, and on as late as the 17th of October, and presumably, weather permitting, much later.

On the 14th of October, Mr. T. P. Newman, who was good enough at my request to make special search as to whether the grubs were still to be found, wrote me from Hazelhurst, Haslemere, Surrey, as follows:—"I am sending you the result of two diggings, one a space of about 24 × 12 inches, the other about 14 × 12 inches. The top three inches contains no grubs at all. Between three inches and six there are few. Below six inches and down to nine inches they are plentiful. Below nine inches down to twelve there are few. Below twelve inches there is little but stone and shale, and there are no grubs."—(T. P. N.) These notes of depth of chief amount of grub presence seem to me of very practical interest regarding remedial measures noticed further on.

On the 17th of October, Mr. Mark Sandford, writing from the Estate Office, Maresfield Park, Uckfield, added the following note of destruction then going on to his previous observations:—"The rooks are very busy in the park each early morning, almost ploughing up the turf for the grubs of the Rose Beetles; no doubt they seem to be damaging the turf very much, but I presume it is the best way to get rid of the beetles, is it not? They seem to know exactly where to find them, as they do not go all over the park, only at certain places, and at those places we can find the grubs, and not elsewhere."

The beetles are easily recognizable by being of the shape and size figured at p. 22, the colour of the head and fore body bright deep green, the wing-cases bright brown. The wings are ample, the under side of the body and legs black. The life-time of this Rose Chafer (*Phyllopertha horticola*) is now known to extend in all its conditions only over twelve months. The beetles, as we know, appear in May, or early in the summer, and feed very especially on Roses, but also on many kinds of leafage. The female beetles then deposit their eggs (up, it is stated, to the number of a hundred) in the earth, and then they die; the grubs from these ravage, as we know, at plant roots, especially Grass roots, and by November are full-sized. During winter they lie in the ground, and presently change to the pupal state, from which the beetles may be expected to develop in May.

The life-history of the Cockchafer, the *Melolontha vulgaris*, is very similar to the above in the main points,—with the exception that the Cockchafer (as shown at page 27) is upwards of four times as large as the *P. horticola;* also it is much longer lived, as it passes four years before it reaches beetle state; and also its flight time is in the evening, not in the sunny hours of the day.

The grubs in both cases are very fleshy, yellowish in general colour, excepting at the extremity of the abdomen, which is more or less swelled out by the contained food into what is called the "sack," which, from this food showing through the transparent skin, has a dark bluish colour. Both kinds have horny brownish or ochrey heads, armed with strong jaws, and also both kinds have six long legs at the fore part of the body. There is no difficulty at all in distinguishing between the kind of the grubs after the Cockchafer grub has passed the full-grown size of the Rose Chafer grub; but previously to that, it appears to me there may be difficulties in technical identification.

For those, however, who wish to be able to identify the two kinds of larvæ with certainty for scientific purposes, the fullest descriptions are available in the work 'De Metamorphosi Eleutheratorum Observationes,' by I. Schiodte, which extend over two or three pages each of Latin descriptions. Not being able myself fully to master the details of the entomological Latin, I most gladly availed myself of the kind assistance of Mr. W. Hatchett Jackson, M.A., of Keble College, Oxford, who was good enough to translate and tabulate the distinctive points for me. The attack was passing away when I became aware of these full descriptions being in existence, and specimens in spirit were not serviceable for certain identification of many of the minute details; but so far as I could judge from the more obvious characteristics besides those which I had observed during the summer; and also that of the power of the grubs of moving about with very fair activity, also their decided difference in appearance from that of a half-grown Cockchafer grub, which I had the opportunity of examining, it appears to me that all the different collections of grubs sent from under the turf (save where otherwise specified) might be safely considered to be those of the Rose Chafer, the *Phyllopertha horticola.*

The following notes of some of the characteristic differences between the two species of larvæ (taken from the work above mentioned), which do not require either high microscopic powers, or minute dissection for their observation, may perhaps be of service.

Larva of Phyllopertha horticola.—Vertical suture of head a very fine line. Epistoma broader by half than it is long. Third joint of antennæ of same length as the first joint. Tibiæ of legs twice as short as femora. Claws of legs increasing in size in the successive pairs. Abdomen cylindrical though somewhat clavate. Anal valves obscurely marked off; lunate in shape. Spiracles orbicular.

Larva of Melolontha vulgaris.—Vertical suture of head deeply countersunk for a short space behind the epistoma, its margins somewhat raised. Epistoma three times as broad as long. Third joint of antennæ nearly one-third shorter than first joint. Tibiæ of legs one-fourth shorter than femora. Claws of legs diminishing very greatly in size in successive pairs, most markedly and abruptly in those of third pair. Abdomen clavate. Anal valves sharply marked off; upper valve triangular, lower valve trilobed. Anterior spiracles short ovate, posterior orbicular.

PREVENTION AND REMEDIES.—So far as appears at present the only really reliable remedy for Rose Chafer attack is shaking or beating down the beetles (see p. 25) in the evening, or early morning, when they are torpid from weather effects, or other causes. If they are shaken down when they are not disposed to fly (as at dusk, in the evening, or in the cool morning hours), they may be destroyed in great numbers. This may be done by hand-picking the fallen Chafers, and scalding them, or they may be gathered off cloths, or sheets of any kind, which have been laid beneath the infested trees before shaking the beetles down, and these collections thrown into scalding water, or into any mixture which will kill them. Where they have to be destroyed on a large scale (similarly to Cockchafer beetles), it may answer to have pigs ready to devour them. But it is important in both cases to be sure to take the time when the beetle is quiet, for with the Cockchafer the dusk hours are its special flight time. Clearing the beetles in this way necessarily lessens the amount which would otherwise lay eggs in the Grass fields, or lawns, or other localities suitable for the purpose.

When the second stage of the attack is doing damage in the form of the maggots feeding at the roots of Grass, then the chief practicable remedy appears to be to take care that the flocks of birds, which tear up the surface of the lawns or Grass lands to get at the grubs, should not be disturbed at their work. It will be seen in the preceding pages that the starlings are particularly useful in clearing the grubs; they are mentioned as coming "in large flocks"; "in thousands"; and also the ground being "black with starlings and missel thrushes." Rooks also are noticed as doing good service in digging up the grubs; and in another observation, a note is given of "birds of all kinds feeding greedily all day." Poultry also of various kinds aided in clearing. Whether turning pigs (not too much rung in the nose) on to the infested ground might not be a still better way of getting the maggots destroyed, is open to doubt; but the more complete ruin of the turf by the ploughing up of their noses than even what is caused by the tearing of the birds, makes the plan objected to.

The depth at which the grubs lie beneath the ground makes it exceedingly difficult to deal with them by applications of surface dressings; but where they lie sufficiently in reach, the following suggestions by John Curtis, or a modification of them, may be of use.[*] "To kill these larvæ, water the Grass in the autumn with one-tenth gas liquor to two-tenths water; it will do no mischief to the Grass, but will extirpate the miners. Where the gas liquor cannot be employed, employ strong salt and water." These prescriptions would need some care in carrying out, and experiment as to strength of application safe to use, or they might only complete the mischief. There is, however, very likely to be this benefit gained by their *careful* application, that even if they did not kill the grubs, they would make the earth so disagreeable to them, that the grubs would go lower down, and do less mischief whilst the effect lasted.

Potash, unslaked lime, and other alkalis, are stated to be useful to strew over infested land before or after the winter season, and gypsum also is mentioned as desirable; but looking at the depth at which they have been recorded as at work in the previous observations, and that to which they can or do go down in winter, which is given, even in November when frost has set in, as much as a spade's depth, it may be doubted whether these applications would do more than help to restore the Grass growth. There is also the point to be considered that the strong smelling or tasted applications, like gas water, might drive off bird help.

After examination of the various kinds of treatment advised for the last fifty years or more for the extirpation of these pests, it still does not appear to me that anything can be surely relied on, excepting shaking down the beetles and destroying them.

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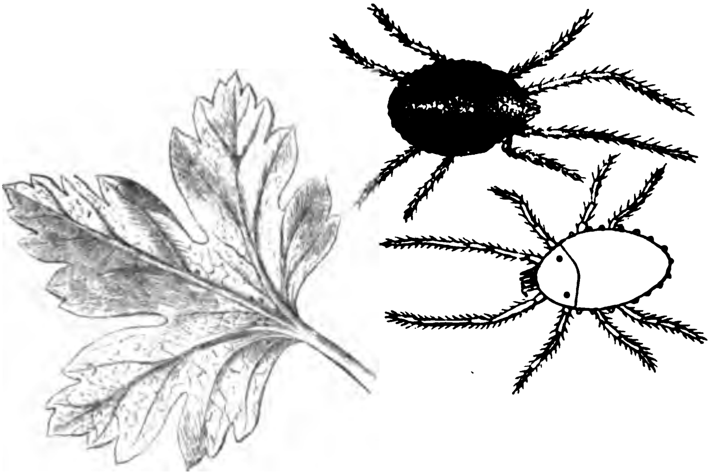
[*] See 'Gardeners' Chronicle' for Oct. 19th, 1844, p. 700.

GOOSEBERRY.

Gooseberry and Ivy Red Spider. *Bryobia prætiosa*, C. L. Koch.



BRYOBIA PRÆTIOSA, from life; B. SPECIOSA (outline figure after Koch): both magnified. Leaf infested by "Red Spider," nat. size.

During the past spring and early summer, Gooseberry leafage was infested to a very unusual extent by a small *Acarus*, or "Mite," commonly known as "Red Spider." This Mite is of a different species to the well-known "Red Spider" of the Hop, and is very commonly to be found on Ivy leaves; but in the past season, without apparently being less present on Ivy, it extended its infestation to Gooseberry leafage to an amount causing serious loss to growers in many localities.

The first report of the mischief that was going forward was sent me on the 15th of March from Great Eversden, near Cambridge, by Mr. Francis Nixon, and from that time until the 21st of June enquiries were sent as to the best means for checking the evil. Letters regarding this prevalence of Red Spider were sent from localities over a large area of country; it was reported from near Rochester and Brighton, and other places in Kent, and Sussex, and near Lymington, in Hants. In Hertfordshire I had it in my own garden, and it was also present at Watford. Special observations of the presence of the Mite as a most destructive pest were sent from various places in Cambridgeshire; notably from near Wisbech, Histon, Meldreath, and Great Eversden, near Cambridge, and from grounds of growers up to an extent of three hundred acres. More westerly, it was noticed as troublesome at Pershore, and also at Evesham, in Worcestershire; it was also reported to me as present in great quantities near Cirencester, by Prof. Allen Harker, of the Royal Agricultural College; and, passing on to the most northerly locality reported from, it was present to a very noticeable amount up to the early days of June in the neighbourhood of Perth.

Not being sufficiently well acquainted with the *Acarina* to be able to identify these Mites trustworthily myself, I applied for help in the matter to the well-skilled determination of Mr. Albert Michael, F.L.S., who kindly examined the specimens for me, and sent me, on the 11th of May, the following reply:—"They belong to the genus *Bryobia*, and are the *Bryobia prætiosa* of C. L. Koch, but I very much doubt this species being different from the *Bryobia speciosa* of the same author; you might really call them by either name; but this variety is Koch's '*prætiosa*.' The creature swarms in millions on Ivy in gardens at this time of the year. I do not think that it usually does very much harm to garden produce, as it prefers the Ivy, but sometimes it does a good deal of damage. If there be Ivy in the garden it comes from, the owner may probably get rid of the Mites at the expense of the Ivy; if he does not do this, the evil is likely to be recurring. You will find that Andrew Murray and Koch class *Bryobia* among the Trombidiidæ, but this is an error; clearly its nearest ally is *Tetranychus*, the common Red Spider."—(A. D. M.)*

At the heading of this paper a magnified figure is given of *B. prætiosa* (taken from life last season), together with a copy of Koch's outline figure of the *B. speciosa*. These give the general form, and especially the great length of the front pair of legs, which is a characteristic of the *Bryobia* (Koch). The size is difficult to state for general purposes, but amongst the specimens I examined, the thirty-second of an inch, that is, the quarter of the eighth of an inch, would give a fair idea of the average length. With regard to colour,—amongst the first specimens which were sent me on the 17th of March, from Great Eversden, by Mr. Francis Nixon, the larger number were brick-red of various shades from bright to ordinary brick colour, and some much deeper and duller in tint. These were in some instances moving about quite actively on the leafage of the Gooseberry twigs sent, which were about four or five inches long, with the leafage well forward, and a little of the blossom bud showing.

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* In Murray's 'Aptera' a short description of the main characteristics of the genus *Bryobia* will be found at p. 117, followed by a figure of *B. speciosa*, after Koch, in which one peculiarly distinguishing point of the margin of the abdomen being set round with short papillæ is indicated. In a paper on "The Clover Mite" (another species of *Bryobia*, namely, *B. pratensis*), by Prof. C. V. Riley and C. L. Marriatt, given in No. 2 of Vol. iii. of 'Insect Life' (Washington), observations will also be found regarding this belonging to the family of vegetable-feeding Mites, the Tetranychidæ. These points are desirable to bear in mind now that they have been clearly defined, to prevent the errors on the one hand of placing this little Mite in a separate division from its nearest allies, and on the other of mistaking it for the only too prevalent Red Spider of the Hop and of other plants.—Ed.

About a month later (amongst specimens sent me from Pitfour Castle, Perth, N.B., by Sir J. Stewart Richardson, Bart.), I found the same kind of "Red Spiders" in great numbers, some bright red and active, and others congregated in the axils of the veins of the leaves close to the origin of the leaf from the leafstalk. This appeared to be a favourite position, and these little parties of Mites were mostly of a darker, or partially of a darker, tint, being in some cases vermilion along the centre of the back of the abdomen, and dark towards the sides (see magnified figure, p. 82). This figure also shows the full number, that is to say, eight legs of the adult Mite; when hatched it has only six.* The web, which is so noticeable under a fair magnifying power in the case of the Hop Red Spider, was very little observable in the early stages of infestation, even where I made special examination with a quarter-inch power; I think I made out that there was a little, but I could not feel certain.

The following are some of the reports of observation sent in the past season. On the 15th of March, Mr. F. Nixon, writing from Great Eversden, near Cambridge, remarked, "It might interest you to know that at this early stage the Gooseberry bushes in this neighbourhood are already covered with 'Red Spider'"; . . . "all have it more or less."

On the 23rd of May, Mr. Nixon, who had been frequently communicating on the subject of the Gooseberry Red Spider presence since his first observation of March 15th, wrote that he had seen hundreds of acres looking ruined by this troublesome pest, and remarked:—"I have been into every fruit-growing district in Cambridgeshire, and everywhere it is the same. Not a single plantation have I found entirely free from it, whilst the ravages in most have been terrible."

Reverting to order of date of appearance: on the 27th of March, Mr. Chas. Whitaker, of Caldewell, Pershore, Worcestershire, applied for information as to remedy for Red Spider on Gooseberry bushes.

On the 27th of April, Prof. Harker, of the Royal Agricultural College, Cirencester, wrote me from Oakley Villas, Cirencester, as follows:—"I dare say this long dry season has put you on the alert for some special developments of insect and other pest life. To-day my boy and I found an amazing phenomenon on the leaves of the wall Ivy, on all the roads and gardens around here. Thousands, millions, of Spinning Mites! One leaf, not very big, had over one hundred specimens, and every leaf for almost acres had some." . . . "I think I never saw such an army of living things."

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* In the paper by Prof. Riley, previously quoted at p. 33, will be found first-rate and very highly magnified figures of *Bryobia pratensis* in adult, and also in young condition, which may be serviceably consulted for differences of structure at different ages. In the case of this "Clover Red Spider" it is noted (pp. 47, &c.) that the eggs are blood-red, and have been found in great numbers during winter on the bark, or under loose bark, of various trees, together with some amount of hybernating Mites.

Later on, Prof. Harker kindly sent me the following additional note relatively to observation of web spun on the infested leafage, which, whilst the attack was only just beginning, I had scarcely been able to find, even doubtfully, and usually not at all, on the sample leaves forwarded to me.

Prof. Harker wrote me:—"After some weeks the enormous numbers of Mites gradually diminished; but they left behind them what had not at first been visible, their common webs, covering the whole of the Ivy for quite one or two hundred yards, from the ground to the top of the six feet wall, and as these webs caught the dust and wind-borne débris of the roadsides they became thick and matted, and quite disfigured the whole Ivy. Up to middle of August a few of the Mites were still occasionally found."—(A. H.)

About the same date as the first of Prof. Harker's observations, given above, that is, on the 17th and on the 29th of April, Sir J. Stewart Richardson wrote to me from Pitfour Castle, Perth, N.B., regarding the appearance of this infestation on Gooseberry bushes, and afterwards also in great numbers on Ivy. On the 17th of April, Sir J. Stewart Richardson wrote:—"I send you some specimens of what in this district is an entirely new Gooseberry pest." . . . "Last year they were very severe on the bushes in a garden about three miles from here, but this year they are destroying my bushes, particularly the Warrington kind, but are not nearly so bad on the Sulphur Gooseberry." The "Red Spider" was very numerous on the leafage sent. On the 29th of April, Sir J. Stewart Richardson wrote further: —"Since writing to you, I find that the same Spider is very bad on the Ivy, both near the garden and on the house (more than a quarter of a mile distant), so that it cannot be called peculiarily a Gooseberry pest."

On the 1st of May, Miss F. Pye, writing from Knight's Place, Rochester, observed:—"We are sending you some specimens of Red Spider. My father says it has been a nuisance on a piece of Gooseberries for the last two years"; and, a few days after, on the 5th of May, Mr. F. Padwick, writing from 101, Buckingham Road, Brighton, requested "information respecting a minute Red Spider which is committing havoc among the Gooseberry trees in the south of Sussex."

On the 6th of May, Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, wrote:—"About a week ago Red Spider appeared in great numbers, and still swarms everywhere, the Ivy on this and other houses being covered."

Various other localities were written from regarding presence of the infestation, as at Meldreth, Cambs, on the 16th of May, where it was noted as "more numerous and harder to kill than ever before." Also from Rossett Holt, Harrogate, Yorks, where a correspondent reported a kind of Red Spider, of which specimens were sent, as being in millions on the south and west sides of the house. Without, however, enumerating all localities reported from, the infestation continued past the middle of June, the latest report of presence being sent on the 21st of June, by Mrs. Manning, from Watford, Herts, as follows:—"One tree was slightly attacked last year. This year it appeared in the same branch, but spread over a great number of trees, and I am very anxious to know what means to use to save the bushes from another year's attack."

Prevention and Remedies.—One important point is to take the attack in time,—firstly, that if even a single bush is infested it should be cleared so as not to make a centre of infestation for the following season; and secondly, when Red Spider is found to be in possession, remedies should be applied without delay.

This point, it will be seen, is strongly noted in the following valuable communication with which I was favoured by Mr. Malcolm Dunn, writing to me on the 28th of September regarding the injurious insect appearances of the year from the Palace Gardens, Dalkeith, N.B. Mr. Dunn remarked:—

"Our worst 'insect attack' this season was in June, just before the hot weather gave way to rain, on the 22nd of that month. The dry weather and great heat brought on a rather severe attack of Aphis and Red Spider on fruit trees; and especially on Currants and Gooseberries fully exposed to the sun. In gardens where means were not taken at once to stop the attacks, the 'Fly' and 'Spider' quickly overcame the bushes, and many hundreds were so badly injured in the market gardens around here, as well as in private gardens, that they have had to be pulled up and burnt. *Spraying* with soap-suds, or a weak solution of paraffin, at once cleared off the insects, if care was taken to apply the spray to every part, especially the *under side* of the leaves."

Amongst some observations sent me by Mr. J. Masters, of Evesham, Chairman of the Fruit-growers' Experimental Committee of that district, he drew attention to the serious nature of the infestation where it was not attended to. Mr. Masters remarked, "We have had some very serious ravages in our Gooseberry plantations by the 'Red

Spider,' especially where growers took no precautions." Also in one of Mr. Nixon's earliest communications, he wrote:—"I am sending you to-day some Gooseberry cuttings of my neighbours. I do not send my own, because they are not nearly so bad." . . . "I dressed frequently and heavily last year with soft-soap, treacle, and quassia." Mrs. Manning's communication from Watford also points to infestation spreading from even one neglected bush.

For attacks of this nature, probably there are no better applications than spraying with soft-soap wash, or mixtures of soft-soap with mineral oil, or with sulphur. Where these can be successfully mixed at home it saves much trouble, but sometimes purchase of a ready-made mixture saves both trouble and much risk, for if the mineral oil and soap wash are not permanently united, they presently separate, and whilst the soft-soap does not do all the good that was intended, the paraffin does much harm.

So far as reports sent me show, one of the most generally serviceable washes for syringing with, when attack is fairly established, is the mixture sold by Messrs. Morris, Little & Son, of Doncaster, under the trade name of "Anti-pest." On enquiry by myself of Messrs. Morris & Co. as to the general nature of the mixture, they replied:—"We have no objection whatever to your stating 'that the Anti-pest is not distantly allied to the Kerosine Emulsion of the U. S. A., but has the great advantage of being easily miscible with water, &c.,' as no doubt this would be somewhat in its favour."

With regard to special observation of the effect of the dressing,—on March 22nd, Mr. Nixon wrote me, after a deal of experimenting, that he was then able to speak confidently regarding Messrs. Morris, Little & Son's Anti-pest, and considered it undoubtedly the best dressing he had tried, and at the same time he forwarded two boxes of specimens of Gooseberry twigs for my examination. On those that had been dressed there were hardly any "Red Spiders" remaining, and such as there were appeared to be all dead; whilst on the twigs that had not been dressed the "Red Spiders" were mostly quite active; and later on, on May 3rd, Mr. Nixon further reported that he considered he had mastered the "Spider," and did not expect to have much difficulty with it in the future.

Amongst other correspondents much troubled with this Gooseberry leaf pest, I suggested to Sir J. Stewart Richardson, of Pitfour Castle, near Perth (see p. 85), that a trial of the so-called "Anti-pest," applied by the Vermorel Spraying Pump, might prove beneficial, and shortly after he favoured me with a note of results as follows:—"I at once sent for Little's Anti-pest and a Vermorel Spraying Pump; . . . the result of the two things is most satisfactory. This afternoon I inspected some of the bushes most affected, which had only been sprayed once yesterday morning, and I could not find a live Spider." . . . "I think the Vermorel Spraying Pump the most wonderful thing for the money I ever came across; it should be in every garden."* The good results remained, for in reply to a request of mine for some more specimens of the Spider, I received a reply, sent on the 3rd of June:—"I shall send you on Monday some infested sprigs of Ivy and Gooseberry. My Gooseberries are cleared by the treatment, but I can get plenty of specimens within a mile."

Very likely many other of the numberless mixtures now purchasable might have cleared out the Red Spider pest equally well, but as this remedy acted satisfactorily in all cases reported to me, and also at no great cost, I usually suggested it, and, as noted, had good reports of its success.

Some applications were noted as doing little good, as for instance, a mixture of soft-soap, quassia, and tobacco; and Mr. J. Masters, writing from Evesham, observed, "Where growers used Paris-green, the bushes are most of them dead."

For general methods of prevention, all cleaning and dressing of Gooseberry bushes during winter, which would remove possible shelters for the Mites, or their eggs, under loose bark, would be desirable; and also (and very especially) all treatment which might destroy the infestation in the ground, or prevent it creeping up the bushes from the ground. One of my correspondents, who bestowed particular attention on this point, observed the "Red Spiders swarming up the stems of bushes" in the early spring; also a report was given me by Mr. Nixon that where the stems of bushes, in his own orchards and in about a dozen other orchards, were greased, there was, in all cases, the same result, namely, the portion between the grease and ground was very quickly covered with Spiders on their way up. And further, during summer, a handful of mould taken up and examined through a hand-glass would show as many as "fifty to one hundred Spiders in it."

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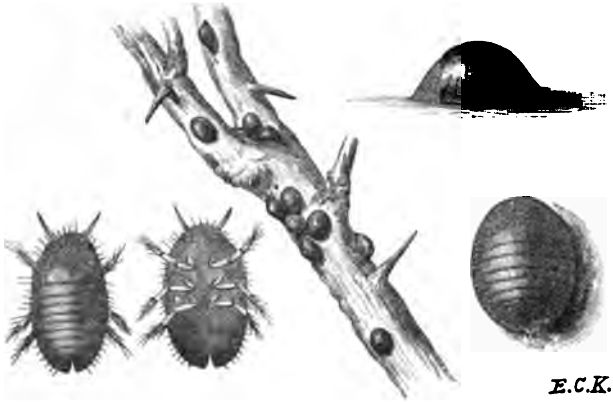
* The Vermorel Knapsack Pump, or No. 1 Eclair Sprayer, is procurable from the English agents, Messrs. Chas. Clark & Co., Windsor Chambers, Great St. Helen's, London, E.C. The price, I believe, is 35/-, or thereabouts. This sprayer, or pump, being easily portable on a man's back, is well adapted for use amongst fruit bushes.

Currant and Gooseberry Scale. *Lecanium ribis*, Fitch.



LECANIUM RIBIS.—Currant Scale, female, showing side and upper surface; larval Scales, with legs still visible: all magnified. Infested Gooseberry twig.

For several years back notes have been sent from time to time with specimens accompanying, of a brown Scale insect found to infest branches of Gooseberry bushes to an injurious extent. It was not, however, until the past season (1898) that, through the kind and skilled assistance of Mr. J. W. Douglas, F.E.S., I was able to ascertain the precise species of this *Lecanium*.

On the 7th of March, Mr. Douglas wrote me as follows regarding specimens I had forwarded to him for examination :—" The Scales on the Gooseberry are certainly *Lecanium ribis*, Fitch. They are familiar to me, for when I lived at Beaufort Gardens they were gregarious on the Red Currant bushes, and sometimes on the White Currant; but I never found they did much appreciable harm. Yet in some places they are very injurious. I have known bushes to be quite exhausted by them, and once I saw an entire bush of *Ribes sanguineum* (the red flowering kind) entirely killed by them. I never saw or heard of them on Black Currant. The male of the species is unknown." . . . " I sent examples to Signoret, and he agreed that they were the *L. ribis*, Fitch. I doubt, however, if the species has ever been fully described; *i. e.*, only the external characters have been given."—(J. W. D.)

The following is the short original note of observation given by Dr. Asa Fitch, of Albany, U.S.A. :—" Currant-bark Louse, *Lecanium ribis*, n. sp., *Homoptera*, *Coccidæ*. A hemispherical Scale of a brownish yellow colour, about 0·80 in diameter, adhering to the bark of the garden Currant; its margin finely wrinkled transversely; often perforated with one, two, or three holes, from which have issued minute brilliant green, four-winged flies, which in their larva state have fed upon and consumed the minute eggs which originally existed under the Scales.

"This is quite common in some gardens, and I suspect has been introduced into this country with the Currant, although European authors have made no mention of a Scale insect as belonging either to this shrub or the Gooseberry. It will be most readily found before the leaves put forth in the spring." *

The method of life of the Scale insect may be described generally, but sufficiently for remedial purposes, as follows. When the soft whitish lobed female, which lies without power of moving within the thin brown Scale, is matured, she produces a multitude of minute eggs, as small as fine dust, which may easily be observed by detaching the sheltering Scale. From these eggs there hatch little flattish oval maggots, which at first have six legs. These spread themselves actively abroad on the boughs, and feed by sucking away the juices, until presently they lose the power of locomotion, turn to the pupal state, and to common observation change in external appearance to the chestnut coloured hemispherical lumps, which are commonly known as "Scale Insects." This thin flexible brown covering shelters the female within; and the sequence of life-history is well given in the following note of observations sent me, on the 15th of July, from Seaford Grange, Pershore, by Mr. Wm. F. Gibbon:—

"I have closely watched the habits of the 'Red Scale' this season, and have verified my observations of last year. The young Scale emerges from the egg early in the spring; I found them hatched out early in February, at first almost transparent, and walking with freedom on six legs; but they soon became of a chestnut colour, and assumed the shape of a small wood louse, flat and oval, and then secured a position by inserting their beak into the bark, and speedily increasing in size. When about three-fourths grown their covering appeared very shiny and sticky, and, later on, dry and harsh. In May I found the Scale matured, and eggs deposited; and on the 18th of June the eggs hatched, and the young *are now* on the move, and it is at this stage of their existence to apply washes for their destruction. The young now wandering about will soon affix themselves to the bark, assume a hard covering, and mature; by autumn deposit eggs, which will hatch next spring. There are consequently two generations in a year."—(W. F. G.)

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* See 'Third Report of Noxious and Beneficial Insects of the State of New York,' by Asa Fitch, M.D., Albany, 1859. This account is also quoted by Dr. Signoret in his 'Essai sur les Cochenilles' (collective edition), vol. 2, p. 624 (462); and this Scale insect is just alluded to by Prof. J. H. Comstock in his '2nd Report of the Department of Entomology of Cornell University Experiment Station, 1883,' in which, at page 135, he refers his readers to the Trans. N. Y. State Agricultural Society, 1856, 427.

Mr. Gibbon also mentioned that this species of Scale insect is very destructive to Gooseberry and Red and Black Currant bushes. I was not then aware of it having been observed on the Black Currant, but on examination of Black Currants in my own, and in an adjacent garden, I found it very definitely present on the boughs, though not to any great extent. On Red and White Currants it was only too noticeable.

The first observations which were forwarded during the past season of infestation of this Scale insect, were sent me on the 8th of February, from Caldewell, Pershore, by Mr. Charles Whitaker, with samples of Gooseberry twigs accompanying, infested by numbers of the female Scales, and also of the little flat dull reddish larvæ, already on the move.

On March 10th, I found the same kind (both females and larvæ) were very prevalent on Gooseberry bushes in my own garden at Torrington House, St. Albans. The female Scales were numerous on the old wood, and mainly beneath the branches where they were sheltered from weather, and where the bark was often split or peeled away so as to expose the under surface; but the infestation was not noticeable (up to this date) on shoots of last year's growth, although the larvæ, and necessarily the female Scales, had for some time previously been observable on the bushes.

The larvæ, or maggots, were so small as to be almost invisible to the naked eye, narrowly oval in shape, with six legs, and a pair of horns (see much magnified figure, p. 39). The colour various, of some shade of puce or reddish, or ochrey tint, and the body somewhat raised along the middle so as to form a slight keel, and the abdomen of the larvæ, as well as the female Scales, showing a more or less noticeable caudal cleft.

The female Scales were hemispherical in shape, sometimes curved slightly outwards at the lowest edge; the colour some shade of nut brown or rich brown; the size variable, ranging from an eighth of an inch to rather more; the width about equal to the length; the height about one-twelfth of an inch, or rather more in the middle. In the best defined specimens the border was finely ribbed transversely; the rest of the surface was so irregularly varied, according to age or condition of Scale, as to make it impossible to give a precise description.

Later in the season (on the 6th of June) the female Scales were plentiful on the old wood of some Gooseberry bushes which had not been particularly attended to, and in most instances were full of eggs. Sometimes the old skin of the mother Scale was almost empty, but in others the quantity was beyond counting, the exceedingly small oval-shaped bodies falling like a shower of white dust, which might be said to cover a space of half an inch square, and well sprinkle about an inch. The Scales which frequently contained the lobed, fleshy, greyish female *Lecanium* within them, were now of different sizes, and of various colour and condition, some being shrunken, so as to show transverse corrugations, and some plump and rounded.

About a month after (on the 11th of July) a few females were scattered on the old branches, some long dead, and flattened against the boughs with the colour faded, others still bright brown and shiny. Beneath them, in some instances, eggs were still noticeable, but commonly empty eggshells were the most observable presence, together with some eggs still unhatched, and some recently hatched or hatching larvæ. And towards the end of July, though I found little larval presence on the Gooseberry bushes, I found, at the same date, a piece of Gooseberry branch, which had been cut and kept under cover for some time, was sprinkled over with multitudes of the young larval Scales. These were scattered in scores, or rather in hundreds, over every part of the branch excepting the withered leaves, but were then dead from the branch having ceased to supply requisite sap. The marked difference in amount was presumably from the young Scales being washed off in out-of-door circumstances, or destroyed by rain, and also being preyed on by small insect feeding beetles, &c., as there were plentiful remains of egg pellicles.

Prevention and Remedies.—Looking at the manner in which the Scales shelter themselves where ragged bark is peeling back on old wood, it is obvious that robbing them of these head-quarters so far as could be managed could not fail to be of service; and next to this, such treatment of the bushes as would allow of not only spraying the infested boughs, but of wash being run down them to lodge amongst rough bark, and would also allow of the oldest of the infested parts, where there was no fear of rubbing off buds, being well brushed with soap mixtures.

Much might thus be done by well considered pruning; but at the same time the pruned off branches should be most carefully removed and burnt. The little larval Scales, though hardly discernible without a magnifier, are actively on foot as early as February, and may perfectly easily wander back from the removed branches if these are left beneath the bushes.

Where Currants are trained in long rods on walls, these require an eye being given, and perhaps a rod occasionally taken out, down to the root. In my own garden I have found the Scales in patches at intervals on a length of several feet of White Currant.

On the 20th of February, Mr. Chas. Whitaker, writing from Caldewell, Pershore, told me that he had had his infested Gooseberry bushes sprayed with "Chiswick Compound," and found it effectual; and in a further communication, a little more than a month later, he added, "I found the Chiswick Compound very effective in destroying Scale." Probably this would be as serviceable an application as could be found, as it is a mixture of soft-soap and sulphur, which act well against these kinds of bark infestations, and it has the advantage of the sulphur becoming soluble (so as to be completely mixed with the wash) in from sixteen to twenty-four hours after the requisite amount of hot water to dilute the mixture to a safe strength has been added.

The mixture is procurable from the Chiswick Soap Company, Chiswick, Middlesex, and is very similar in composition to a mixture used with success in South Australia (under the name of "Burford's Soft-soap and Sulphur Compound") against several kinds of bark attack, as Aphides, Red Spider, &c. Probably any of the common soft-soap washes, especially those that are mixed with sulphur and mineral oil, would be of use, and if a stronger application was needed, the following recipe for "Burford's No. 1 Kerosine Soap" might be of use.

"Take equal weights of kerosine and soft-soap and stir together in a convenient vessel, which should be placed in the sun in summer, or in a bucket containing hot water in the winter time. In from ten to twenty minutes' time the two ingredients will coalesce, when it can be diluted as required"; * probably in this country the hot water would be more to be trusted to than the heat of the sun at any time of year.

To the above suggestions of preventive or remedial treatment may be added, with regard to date of clearing infested boughs in winter pruning, that it is desirable this should be done, and the Scale-infested boughs cleared from the ground and burnt before the time when the larval Scales will be hatching and dispersing themselves about bushes. It should be done quite by the commencement of February. Also it is desirable, after the prunings have been gathered up, to *stir* † *the surface* of the soil under the bushes, and to throw a little quick-lime, or any preventive mixture preferred, on the soil just round the stems to prevent the little Scales making their way back to the branches.

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* The above, and other useful recipes, will be found in the 'Report on the Fusicladiums (Black-spot, Scab, and Mildew Diseases), Codlin Moth, &c.,' by the late Frazer S. Crawford, Inspector under the Vine, &c., Protection Act, South Australia. E. Spiller, Government Printer, Adelaide.

† In mentioning that stirring the surface soil and throwing on quick-lime is useful, I most particularly wish to observe that I do *not* advise "deep digging" under the bushes as a preventive measure for this or any other Gooseberry attack. As far as I am able to form an opinion, such a measure would be injurious in the extreme to the roots of the Gooseberry bushes, and as a remedial measure for infestation of Gooseberry Sawfly, as I have recently seen recommended, it would (as is well known to practical workers) fail in beneficial effect, as it would merely disperse a large proportion of the cocoons. In this case the surface should be skimmed off no deeper than is necessary, and destroyed with the contained cocoons.—(E. A. O.)

HOP.

Minute Black Lady-bird. *Scymnus minimus*, Rossi.*

(Beneficial insect; feeding on "Red Spider.")

Amongst injurious infestations of Hops, that of Red Spider was especially troublesome at Hop harvest time in the past season, and about the end of August, when in many of the south-eastern Hop growing districts picking was being hurried on, or crops severely suffering from presence of Red Spider,† I received information of observation of a small black Lady-bird Beetle, of which the maggots preyed greedily on this pest.

The first communication regarding these little Lady-birds was sent me on the 5th of August, from Canon Court, Wateringbury, near Maidstone, by Mr. Edward Goodwin, with the remark that he was forwarding to me some larvæ which he had found that day feeding on the Red Spider of the Hop. This first consignment, however, had escaped in transit, or what was more likely, judging by subsequent observation of habits of the maggots, had destroyed each other past recognition during the journey!

From various causes, the second consignment was not sent me until near the end of the month, on the 25th of August, when Mr. Goodwin wrote:—"I regret the delay in sending you more specimens. Unfortunately the wash we used was more successful in killing the larvæ which prey on Red Spider than the Spiders themselves. I am sending you a very few of the larvæ and pupæ. I could not find any of the beetles; they are very small, black, and evidently allied to the 'Fly Golding.'"

On the 5th of September, Mr. Goodwin added further:—"The larvæ and pupæ are usually found in groups of four or five, and their habits appear to resemble those of the Lady-bird. I can find plenty of them now."

The beetles, which I reared from the pupæ (and in one instance from the larvæ sent me), proved just like miniature black "Lady-birds" in general appearance. The shape hemispheric, or rather oval; length rather less than one line; colour shining black; legs testaceous, with darker thighs; antennæ clubbed, testaceous, lowest joint darker;

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* This beetle is not figured, as from its very minute size, a black dot, a twelfth of an inch across, would be the only way of representing it as seen in life. The figure of various Lady-bird Beetles, in different stages, given at p. 46, show in much larger form, the shape of the small *Scymnus* in beetle, chrysalis, and grub condition.

† See 'The London Corn Circular' for August 28th, with "Crop Prospects" of Hops, p. 6.

elytra pubescent and finely punctured. They do not appear to have any popular name; scientifically, they are the *Scymnus minimus*. As I had not met with the species before (though I believe it is not uncommon), I submitted my identification for verification to Mr. O. E. Jansen, who pronounced it correct, and that the beetles were the *Scymnus minimus* of Rossi.

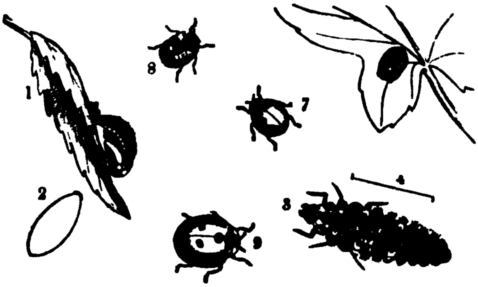
The larvæ (maggots) sent me, which were then on August 26th fully grown, were about an eighth, or rather less than an eighth of an inch in length, and about a third of that width, furnished with six claw-feet, and with a sucker-foot at the end of the tail; remarkably nimble in their movements, and with such power of holding by the tail sucker, that the grub could turn over nearly on its back. Shape narrowly oval. Colour, to the naked eye, smoky grey; on examination with a two-inch object-glass, of a smoky yellowish colour with black markings. The head with some small black marks; 1st segment with two square black patches above; 2nd with two longer black patches; 3rd with two long, but narrower black patches. The rest of the body marked lengthwise, with six rows of black tubercular spots with bristles. On examining the black patches and tubercle-like warts with a higher magnifying power, these proved not to be each a single spot, but composed of a number of little black dots, each aggregation bearing two, three, or, on the larger patches, many white hairs, with here and there a few black hairs also.

On placing the maggots on some Plum leaves infested by Red Spider, I found them shortly after busily feeding. The operation seemed to be going on uninterruptedly and greedily, like sheep browsing on a new pasture. Failing other food, the maggots appeared to prey on each other, for of a few which I had (for convenience of examination) in a corked glass tube, I only found first two or three, and, later on, one live maggot remaining, besides a contorted skin and possible fragments, from which I conjectured the missing specimens had been eaten or destroyed by their companions.

The remaining maggot went through its changes rapidly. On August 28th it was still in larval state; it soon changed in the usual manner of the Coccinellidæ, or "Lady-birds," to a shiny black pupa, suspended to a leaf, and on the 6th of September the beetle had developed, and was walking about actively.

From the good number of specimens sent me, I was enabled to watch the development from larval condition onward to that of the perfect beetle, and I have given notes as above of the chief points observable, as I am not aware of the history having been noted before. The only special reference which I find to this *Scymnus minimus*, as a destroyer of Red Spider, is given by Dr. E. L. Taschenberg in his 'Praktische Insekten Kunde,' pt. v., p. 154.

The figure appended of some of our better known, and very much larger Lady-birds, conveys equally well the shape (much magnified) of the little black *Scymnus* and its larva, and also the manner in which it suspends itself for its pupal change. With these larger species of Coccinellidæ, the attempt has, I believe, been sometimes made, with tolerable success, to preserve the beetles during the winter, and to turn them loose afterwards to prey on the Hop Aphides. How far such a plan could be carried out, excepting just as a matter of fancy, might be doubted, but in the case of the little *Scymnus*, through the courtesy of Mr. Goodwin, I have been supplied with a sufficient number of specimens to found (if they prosper) a colony in my garden. As far as I see, the flight of the beetle is very short, and if established in a spot where they may hybernate undisturbed, their services may just possibly (without any attention having to be bestowed on them) be secured for next season.

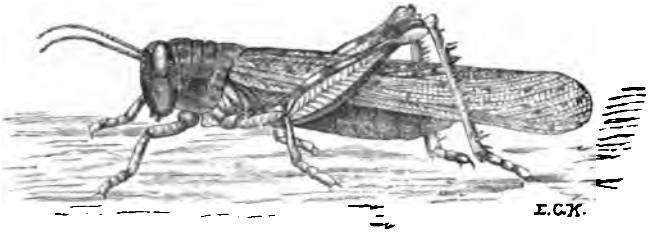


COCCINELLIDÆ.—1, cluster of eggs; 2, egg, magnified; 3, grub, magnified; 4, line showing nat. length; 5 and 6, pupæ; 7 and 8, 2-spotted Lady-bird, and dark variety, sometimes known as *Coccinella dispar*; 9, 7-spotted Lady-bird.

LOCUSTS.

Locust (a species of Southern Europe). *Acridium ægyptium*, L.

South American Migratory Locust. *Acridium* (*Schistocerca*) *paranense*, Burm.



ACRIDIUM ÆGYPTIUM.

In the early part of the past year (1893), some specimens of Locusts which had certainly, in some cases, and presumably in all, been imported into this country, were forwarded to me by correspondents. Of these, two very fine specimens, sent from two different localities, were still alive, and one in active condition; others which were dead, and obviously had been so for some time, were found in such great numbers in Lucerne (Alfalfa), imported as fodder from Buenos Ayres, in South America, that it was estimated there was one Locust to each pound of hay in the fodder examined.

Later on in the year, at the beginning of September, another application was sent me on the part of a farmer in the neighbourhood of Caversham, in Oxfordshire, who had just purchased some "foreign hay," and found quantities of Locusts in it to the amount of "not less than two hundred specimens in one truss." These Locusts (with one possible exception) appeared to be of precisely the same species as those imported from Buenos Ayres, and like them were all dead.

The figure at the head of this paper, which was sketched from one of the live specimens sent me, gives also a good idea of the general appearance of the fine insects, commonly known as Locusts, when at rest, or preparing for one of their long leaps.

For common purposes, Locusts may perhaps be best described as a very large kind of what, in this country, we call "Grasshoppers," and the family to which they belong (*Locustidæ*, Leach) is distinguishable from others of "Saltatorial Orthoptera," such as our English House Crickets, Field Crickets, and the like, by the horns, or *antennæ*, being thread-like, or cylindric, and short, not exceeding the body in length; by the wing-covers, and the folded wings beneath them, being deflexed, that is, not placed horizontally, but sloping like the roof of a house;

and also by the ovipositor not being exserted, the extremity of the tail not being prolonged into a long egg-laying apparatus. The size is very variable, from that of the little Grasshoppers, which we are well acquainted with here, to from two to about three inches in length from head to tip of wings when at rest in the case of some of the larger Locusts of the western and eastern world.

The first specimen I received in the past season was sent me on the 31st of January, from Harlington, Middlesex, by Mr. Robert Newman, with the remarks:—"I have just had handed to me a species of Grasshopper, which I send to you by this post. The same was found in a white Brocoli bought in the London market, and which was sent there from some foreign district. I shall be glad if you will tell me what it is, and whether there is any reason to fear danger from the importation of the same."

On examination of the specimen, it seemed to me that it was most likely it had been imported from the south of Europe, and on enquiry I found many Brocoli had then been lately imported from Spain.

A few days after receipt of the above specimen, another Locust of the same species, though rather larger and somewhat differing in marking, was forwarded to me by favour of Messrs. West, Newman & Co., 54, Hatton Garden, London, E.C., with the following note:—"This morning a lad named Fursdon, kitchen-boy at Spiers and Pond's Aldersgate Street Hotel, brought the Locust sent herewith, which he had found among some 'greens' sent in from market. I could not extract any information as to the origin of the greens. It struck me that here might be the importation of a serious injurious insect attack, and so send it off to you."—(T. P. N.)

Both of the above specimens were alive, and apparently in good health. The length of the specimen figured (p. 47) was two inches or slightly less in the body; two and three-eighth inches from head to tip of upper wings when at rest; general colour reddish mottled with greyish, yellowish red mark at the hinder part of the head, and eyes with alternate fine longitudinal lines of black and yellowish, these upwards of fourteen in number. The narrow parchment-like, and somewhat transparent, upper wings dark grey, mottled with many darker grey spots, these smaller along the fore edge. The posterior legs with three dark blotches along the upper part of the thigh (*femur*), and the shanks (*tibiæ*) with white spines black at the tip. The above short description of the general appearance of these Locusts, together with the figure at p. 47, will perhaps be sufficient for agricultural use; those who desire full technical details will find them excellently given in the work noted below.*

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* 'Sinópsis de los Ortópteros de Espana y Portugal,' par Ignacio Bolivar, Madrid, pp. 88, 89.

As I have not a type collection for reference, it was impossible for me to identify the specimens trustworthily, and I therefore forwarded them to Senor Don Ignacio Bolivar, Professor of Entomology in the University of Madrid, well known for his long and also widely extended observations on the Orthoptera, who was good enough to identify them for me as the *Acridium ægyptium*,* L., and to write as follows regarding them:—

"Nos. 1 and 2 certainly correspond to the *Acridium ægyptium*, L. They may easily have been imported into England with field produce from the whole of Southern Europe, where the species is common. In the neighbourhood of Madrid this kind may be found in fully developed condition during nearly the whole year. It does not cause ravage, as it is not found in great numbers, but always as isolated specimens, and scattered at considerable distances."—J. B. (Trans. E. A. O.)

Besides the above specimens, which arrived in living condition, I received, on the 3rd of February, a packet of large dead Locusts, which proved on investigation to be the *Acridium paranense*, of Burmeister, and which were then being sent over from Buenos Ayres, in fodder, in such numbers as to cause enquiry whether the great quantity might prove injurious to cattle or stock consuming the Locusts with their food.

On this point the following communication was sent me on the 2nd of February, by Messrs. Porter & Wilson, from Jamaica Street, Liverpool:—"I beg to hand you sample of insects taken from Alfalfa grass or hay, which is being landed at this port from Buenos Ayres. In two samples I have examined, the quantity averages about one insect to each pound of hay. The specimens are not quite perfect; they have some long legs, which got broken off through being entangled amongst the leaves of the herbage, which is very full towards the top, something like the Vetches of our country. I shall esteem it a great favour if you will kindly tell me the name of the insect, and if it is injurious to horses or cattle."

It may be just noted in passing, that "Alfalfa" is the Spanish word for Lucerne. With regard to possible damage, as a presence of infestation at the above-named proportion would be calculable as at

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* Synonyms of *Acridium ægyptium*, L.:—

"*Gryllus* (*Locusta*) *ægyptius*, Linneo. Mus. L. Ulr. pagina 138 (1764).

"*G. cristatus*, Asso., 1784. Introduct. in Or. et Zool. Arag., page 111.

"*G. lineola*, Fabricius, Ent. Syst. 11, p. 54.

"*Acridium lineola*, Serville, Hist. Nat. des Orth., p. 656.

"*A. tartaricum*, Serville, id., pag. 657 nota. Fischer, Fr. Orth. Eur., p. 388 t. xv., fig. 27, 27*a*.

"*A. ægyptium*, Staal, Recens., 1*a* part, p. 63."

See page 88 of the work above quoted.

2240 dead Locusts to the ton of fodder, the point of whether or not they might be prejudicial to the health of stock certainly appears of some importance. So far as the bodies of the Locusts are concerned, these might be considered perfectly harmless, from the knowledge we have of the manner in which various animals feed on them, when they can get a chance; also when cooked, and the legs removed, they have long been known to be in some localities an article of human food. But when the insects are consumed entire in a dried state, and in great numbers, it appeared to me open to doubt what effect the hard legs, and especially the hinder legs, with the shanks about an inch in length beset with sharp spines, might have by causing internal irritation, or in the case of cattle, forming balls. Therefore, as I was unable to give a trustworthy opinion on the subject, I suggested it would be well to apply to a veterinary adviser.*

This species of Locust is one of the migratory kinds of South America, of which the native home is stated to be in the higher barren plateaux of the Argentine Republic, and which are recorded as abounding in the provinces of the La Plata river. It is of this kind that Darwin, in his journey across South America from Buenos Ayres to Mendoza and Chile, fell in with a vast swarm just alighting from their migratory flight in the neighbourhood of Luxan, † about a hundred miles from the first-named city.

With regard to the large Locusts mentioned above, as forwarded to me in "Alfalfa hay" imported from Buenos Ayres, they appeared to me to be the *Acridium paranense;* but as I could not feel certain I forwarded specimens, together with those of the *A. ægyptium*, to Senor Don Ignacio Bolivar at Madrid, who kindly confirmed my view as follows:—"No. 8 is, without doubt, the *Acridium* (or rather the *Schistocerca*) *paranense*, Burm., which causes much ravage in the southern parts of America."—(J. B.)

The specimens in the flattened damaged state in which they reached me were of a general brownish colour. The head mottled with various tints, including reddish pink; the body between the wings striped lengthwise above with various shades of yellowish brown, and deeper brown, or with deep brown striped with a still deeper shade; the hind shanks coral-red, with white spines, black at the tips. The narrow parchment-like upper wings with a pale narrow stripe at the fore edge, and also for rather more than half the length at the hinder edge, with an area between the two stripes, narrow at the base and gradually widening, marked with angular brown blotches, these dark near the base, and fainter towards the tip of the wing. Beneath these elytra or upper wings is folded a pair of delicately transparent wings of ample size.

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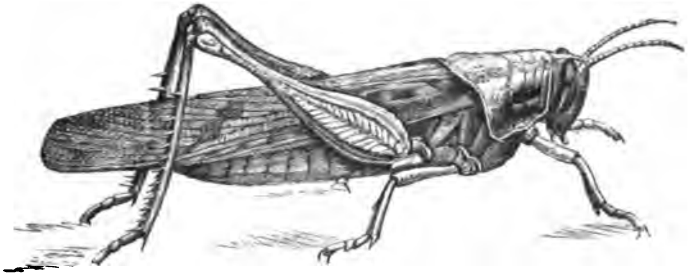
* In the course of further search on Locust life, I noticed the following communication to the editor in the 'Agricultural Journal,' published by the Dep. of Agriculture for Cape Colony, No. 16, Vol. vi. (August, 1893, p. 311):—"The sheep have been living on live Locusts for the last three months, which has (as we think) caused abortion in a large number of the ewes. Mr. Jim Miles informed me that all his ewes had cast their lambs prematurely, and therefore the sheep do not seem to recover as they should."—(J. K.) The consumption of Locusts to such an amount as to be considered the sole article of diet of the sheep, is of course very different to even the large numbers above mentioned as mixed with the hay; still the observation may be worth notice.

† See 1st Report of U.S.A. Ent. Com., p. 466; and for list of publications on S. American Locusts, see App. xxvii. to same vol., pp. [278] and [279].

The colours of the body were necessarily to *some degree* altered by the conditions of transit, but the accompanying figure of the "American *Acridium*," the *Acridium* (or *Schistocerca*) *americana*, Drury, gives a very good idea of the appearance of the specimens sent me from Buenos Ayres, and especially of the quadrate fuscous markings on the upper wings.



AMERICAN ACRIDIUM.—*Acridium* (*Schistocerca*) *americanum*, after Riley.

This Locust is one of the migratory kinds of North America, but appears almost to require mention here on account of its great resemblance (or, as some consider, its probable identity) with the *A. peregrinum*, the migratory Locust of North Africa and S. Western Asia, which species is also so exceedingly similar to the *A. paranense*, entered on in the preceding pages, as to make it doubtful whether these also may not be mere varieties of one species.

In the 'First Report of the U.S.A. Entomological Commission,' p. 87, it is noted, in observations of this North American *Acridium*, "that one of the most destructive migratory species of South-Western Asia and Northern Africa (*Acridium peregrinum*) is not only congeneric with this species, but so closely resembles it that ordinary observation would scarcely detect the differences between the two." And (continuing the records of similarity) various writers are of opinion that this *Acridium peregrinum* does not really differ from the *A. paranense* of the Argentine Republic. Thus we have before us the very interesting fact of these migratory hordes of the genus *Acridium*, which devastate respectively part of North America, part of South America, and also the South-West of Asia and the North of Africa, being so exceedingly similar to each other in appearance, that although they are specifically distinguished as *americanum*, *paranense*, and *peregrinum*, it is at least open to doubt whether they are not all of one species.

Under the name of *Acridium peregrinum*, this large Locust of India and Africa occasionally visits our shores, but there does not seem to be any reason to apprehend that either this kind or any other of the Locust family (as distinguished from the small form, known in this country as Grasshoppers) will make good an establishment in this island.

From collation of information, and also of quotations given in the U.S.A. Department of Agriculture reports, and also Entomological records of this country, it appears that the first trustworthy return of noticeable Locust migration reaching us was when the migratory Locust, *Pachytylus migratorius*, after multiplying in Southern Russia in 1844, passed westward and northward in the following years; and in 1846 numerous flocks of Locusts were recorded as observed in the South and North of England, in Scotland about Aberdeen, and in the Shetlands. Since that date Locusts of various species have been not unfrequently recorded scientifically, as present in various parts of the country, usually as single specimens, or just a few, and now and then (or at least once) in numbers, described as an erratic flock. But so far, as I find these Locusts were all fully-developed specimens; I cannot find any notice of appearance of the insects being in any case followed by observation of them in their early conditions.

The Locust is one of the insects which does not alter in general shape from the time that it hatches out of the egg to its maturity, save that at first it is totally wingless. The little infant Locust (as I had once an opportunity of seeing myself) is hearty and brisk as can be, just after coming out of the egg; and as soon as food supply is exhausted in localities where a great hatch has taken place, the young destroyers move on devouring (in the words of the U.S.A. official report before me) "all the grass, grain, and garden-truck in their path." In due time, after successive moults, as the creature grows to full development it acquires wings, the upper pair narrow and somewhat parchment-like, the lower transparent, and of such great size as to require many folds to pack them away beneath the upper pair; and if the pasturage is not sufficient, and it is one of the gregarious and migratory species, the Locust and its millions of brethren set forth on their wanderings in the vast armies in which its presence has been recorded as one of the scourges of the earth for thousands of years.

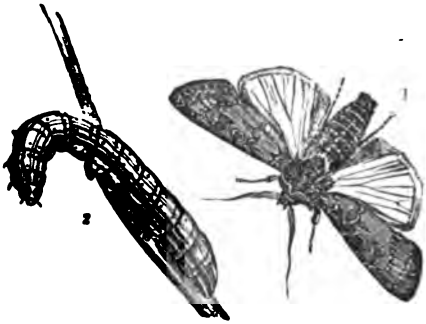
The eggs are laid in the ground, and the average time of development, from date of hatching to maturity, is given in the cases recorded regarding *Acridium americanum* as being seventy days.

With regard to this country, it is probable that from climatal, as well as other considerations, there is not the least cause to fear establishment of this infestation; still as the observation of these great insects necessarily attracts much attention, and sometimes not unnatural apprehension, and as with the increasing amount of importations of human food and cattle fodder it is probable their presence will be more frequently observed, it has seemed perhaps desirable to give a few notes in connection with the insect observations of 1898.

Note.—Those who wish to follow up the subject will find enormous masses of information on almost every point connected with Locust life-history, whether Entomological, Geographical, Meteorological, or Historical, with methods of prevention and remedy, in the large volumes entitled respectively 'First, and Second, Annual Reports of the U.S.A. Entomological Commission, Washington'; also in Appendix xxvii., pp. 278–279, of 1st Report above named, will be found bibliographical references. Much information will also be found in successive reports of the State Entomologists of the U.S.A. Information on the "Locusts of Bengal, Madras, Assam, and Bombay," will be found in the 'Indian Museum Notes,' Calcutta, prepared by Mr. E. C. Cotes, of the Indian Museum; and many short notices of observation of appearance of Locusts in Great Britain will be found by reference to indexes of the 'Entomologist's Monthly Magazine.'

MANGOLDS.

SURFACE CATERPILLARS.—Caterpillars of the **Turnip** or **Dart Moth,** *Agrotis segetum,* Ochsenheimer; **also of the Heart and Dart Moth,** *Agrotis exclamationis,* Linn.



AGROTIS SEGETUM.—Common Dart or Turnip Moth and caterpillar.

So surely as the year comes round, damage, more or less severe, is caused to root crops by the large grubs, known as "Surface Caterpillars," of which one of the two commonest kinds is figured above, and the other at p. 59, together with the moths, to which they respectively turn. In some years these caterpillars are so constant in their presence that they have been reported as observable during almost every month. This was the case in 1884, when observation of the grubs as lively and active began in February, and still on the 18th of December the same kind was reported (due details and specimens accompanying) as ravaging in the neighbourhood of Selby, Yorks, to a serious extent.

Commonly, however, though their life in regular course extends through the winter, they are so much acted on by ordinary amount of cold, as to rest quietly without doing much harm at a depth beneath the surface, where they are safe from weather influence. Commonly also, although these caterpillars are destructive below ground to almost any of our root crops on which they may chance to have established themselves, they are so very especially injurious to Turnip bulbs, that the names of Turnip grub and Turnip Moth are given to the infestation. It is in connection with this crop, and under this name, that this infestation has chiefly been noticed in the preceding numbers of these Reports; but in the past season, although the grubs did not fail to make their customary appearance at the roots of Turnips, Potatoes, &c., yet it was to Mangold roots that they were so especially and unusually injurious, that the attack was in many places not recognised as being of the old established kinds of "Surface Caterpillars," and enquiry regarding its nature was forwarded from many localities, chiefly in the south of England.

The first communication was sent me on the 19th of June, by Mr. W. H. Hunt, from Outmarsh, Trowbridge, Wilts, with specimens of grubs which were destroying his Mangolds by "eating them off just under the ground," and an enquiry as to what was the best remedy. All of the specimens, that arrived in fair condition, were apparently caterpillars of the Turnip or Dart Moth, *Agrotis segetum*, but they differed much in age, and also in colour, from a pale tint to such a deep colour that the spots on the back were hardly distinguishable. Amongst the difficulties of certain identification of the very similar common kinds of "Surface Caterpillars" from each other, it should not be overlooked that whilst some of a consignment may be shrunken, and altogether out of typical condition of colour and skin, from starvation and knocking about in transit; that others may be glossy, and as full as they can hold, apparently simply from consumption of their fellow-travellers.

On the 3rd of July, Mr. Edw. R. Berry Torr, wrote me regarding prevalence of grub in Mangolds as follows, from Westleigh House, Bideford, N. Devon:—"The grub is in the Mangold nearly throughout the county; . . . many farmers have no Mangolds left; . . . my neighbour has all his men and their children picking them from round the plants." In this case specimens were not sent, but a little more than a month later, on the 10th of August, Mr. Berry Torr, continuing the subject, added:—"*Re* Surface Caterpillars,—they have been most troublesome here this season, though I have got on far better than many of my neighbours. They have devoured Cabbages, Mangolds, or anything else they could get at, and nothing seems to stop them."

On the 6th of July, the Rev. W. F. Newman, of Hockworthy Vicarage, Wellington, Somerset, who was then having the Aphides *

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* In a communication sent me by the Rev. W. F. Newman, on the 1st of July, he mentioned that his Mangolds had been attacked by what I found on examination were Aphides, commonly known as Plant Lice. These being on the under side of the leaf, the measure tried of dragging a bag over the leafage did little good. Therefore Mr. Newman put on a body of workers to remove the Aphides by rubbing them off with their hands; but for the sake of himself and his neighbours, he was desirous to know whether there was any more expeditious remedy. Later in the year, on September 13th, he further mentioned, "My crop of Mangolds that was hand-rubbed for Black Aphis promises to be a very fair one."—(W. F. N.)

On the same day, that is, on the 1st of July, Mr. G. A. Winder wrote to me, from Fairmile, Ottery St. Mary, regarding "a terrible pest on the Mangolds" in the shape of fly. This also infested a weed growing among them, locally known as Calf-tongue, on which there were likewise some beetle grubs observable. On examination the insects proved to be Mangold Aphis, with the grubs of Lady-birds, which are amongst our best natural helpers against Aphis attack, already in attendance.

This attack, like that near Wellington, Somerset, was during the continuance on a three-acre field of Mangolds carefully attended to, wrote me that some sort of grub was found at the roots, of which he was going to send a specimen, as it had been pretty general there in its depredations, and two days later he forwarded me samples with the following note:—"According to promise I am forwarding three specimens of Mangold grub just sent down to me by a farmer in this parish." . . . "They attack the root of the plant, and I hear that several farmers in the neighbourhood have ploughed up their Mangolds because of the depredations of these active little gentlemen." The sample was much shrunken on receipt, but was of "Surface Caterpillars," and so far as could be made out by markings still noticeable was of the *Agrotis segetum.*

On July 7th, Mr. Wm. Hooper (Editor of the 'Farmer's Gazette,' Dublin) favoured me with the following note of damage to Mangold plants then going on in the neighbourhood of Thorne, Yeovil, Somerset, where he was then staying; samples of the infestation, which proved to be of Surface Caterpillars, were sent accompanying:—"Many Mangold plants here are bitten off at the root, like, and by the enclosed specimens." . . . "These specimens are from a farm at Thorne in the occupation of Mr. John Marsh, and similar damage has been done on contiguous farms."—(W. H.)

Specimens of Surface Caterpillars were also sent to me on the 30th of July, from Dare Field, Chudleigh Knighton, Newton Abbot (South Devon), by the Rev. F. G. Riley, as samples of a grub which was causing the greatest destruction amongst Turnips and Mangolds, and was also (in his own garden) eating off Cabbage plants. Mr. Riley urgently begged for information which might help them in dealing with the infestation, adding the remark, "We seem to be helpless and without remedy against the enemy, so numerous are they this year, as many as fifty round a single Mangold."

Numerous specimens of Surface Caterpillars were again sent me somewhat later on by the Rev. W. F. Newman with the observation, "I have now procured some more of the Mangold grub from a farm of mine up the Dart." Some of the specimens sent were apparently fully grown.

From Kent, and, later on in the season, from some other southerly

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of the general drought, and appears worth mention just to show the prevalence of insect attack under the circumstances. In 1885, during a time of drought, Mangolds, as well as Turnips, were infested by Aphides. These are sometimes taken for the so-called "Collier," the black Bean Aphis, but are more probably the *Aphis papaveris*, which is known to infest Mangolds, or the *A. atriplicis*, which is found on *Orache* and other plants nearly allied to Mangolds. From the many points of resemblance between these three kinds, specimens are needed for certain identification.—Ed.

localities, notes were sent of damage to Mangolds from Surface Caterpillar attack.

During July, an enquiry was sent me on the part of Mr. John Pye, of Ranscombe, Cuxton (near Rochester, Kent), regarding caterpillars, apparently of the *A. segetum*, which were doing great damage in a field of Mangolds.

Early in September, Mr. F. O. Solomon (Lecturer on Agriculture in connection with the Durham College of Science) forwarded specimens of Surface Caterpillars from Southfield, near Dartford, as samples of grubs which were doing great damage on farms in the neighbourhood of Cobham (Kent), but which were, so far as observed, not attacking any but the Mangold crop.

At a locality in Essex (Greenhills, Earl's Colne), damage to various root crops was reported to me on September 22nd, by Mr. J. A. Tawell, as being caused by these "surface" grubs. Mr. Tawell mentioned it as "a recent trouble that has come to the Mangold, Potato, and Turnip roots," of which he enclosed specimens, adding, "the Mangold is seriously attacked; the Potato as you will see." The sample of Potato attack showed the damage to be very great, the caterpillars, of which samples were forwarded, having eaten great holes into the tuber.

I was also kindly favoured by Mr. Thos. Collins, of Birtley, Witley, Surrey, with some interesting notes of observation as to presence, &c., of Surface Caterpillars on the Earl of Derby's estates in that neighbourhood. On the 23rd of September, Mr. Collins wrote, amongst some other observations on field insect pests:—"There is a dark coloured grub which has done a lot of damage in the Mangolds this year. It began when the plants were very small, and may still be found amongst them in large numbers. It seems to abound on almost every farm in this district this year. The men have looked carefully for them when hoeing, and killed great numbers of them."

A few days after, in a communication regarding some differences in colour of the grubs, and some details of other attack, Mr. Collins mentioned: "I know of two or three instances in which the Mangold seed was put in very late, and which were comparatively free from grub, whilst those drilled about the second week in May were rather worse than the earlier ones."

This difference in amount of attack appeared to me to be very likely attributable to the Mangolds not having come up and been ready for attack, before the moths laying the eggs, which produce the surface grubs, had passed away. *Commonly* weather is variable, and also locally different, and there is very likely to be difference in dates of insect presence, which, if early hatches of the moths had died out, might supply us with plenty for later attacks. *But last season* the long steady drought gave us a widespread similarity of weather, which, conjecturally at least, might give great similarity of date to these caterpillar pests.

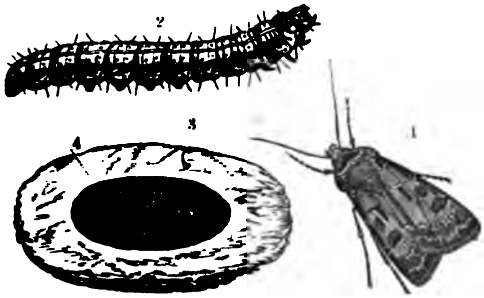
On suggesting this to Mr. Collins, he considered that this was very likely the explanation, and wrote me:—"No doubt your suggestion is correct about the moths being hatched and laying their eggs before the late sown Mangolds were up, and this would also account for the little damage the caterpillars have done to the Swedes and White Turnips compared with the Mangolds, which were sown earlier. The very first sown Mangolds did not suffer quite so much as those sown about a fortnight later, but perhaps they were larger plants, and better able to withstand the attack of the grub. In some places they are producing half a crop where the second sowing had to be ploughed up again."—(T. C.)

Other communications were sent me regarding damage from Surface Caterpillars then going forward to various crops, especially Turnips; but also to roots of Cabbage and Strawberry plants, and to Maize. From Wickham Market, Suffolk, the grub was reported, on July 24th, as doing immense mischief to the Turnip crop in the neighbourhood by biting the root of the young plant in two. From near Cheam, Surrey, at nearly the same date, a correspondent mentioned he had several fields of Brussel Sprouts, and Cabbage, which were being eaten off by the pests, and that they had also attacked a field of Strawberries.

On the 24th of July, Mr. G. S. Mitchell, writing from Adhurst St. Mary, Petersfield, Hants, mentioned attack, which proved like the others previously noticed to be of Surface Caterpillars, having "first appeared in a field of White Turnips, and have quickly cleared off about four acres quite clean." At date of writing, Mr. Mitchell noted, they seem now to be firmly established in the next field, which is Maize sown for ensilage purposes; and a few days later he added:—"The number of caterpillars seems now to be very materially reduced, owing to a heavy night's rain we have had, but I fear it looks very doubtful for second drilling of Turnips, which are now just coming up." He also mentioned in the same letter: "I have just heard from one of our neighbours, who farms upon the chalk, that he has lost all his Mangold and Rape by apparently this same pest."

A note of enquiry was also sent me from Peterborough, on the 30th of August, by Mr. Sidney T. Smith (Proprietor of the 'Peterborough Express'), requesting information and advice as to best method of extirpation of the grub which was then destroying the White Turnips in the surrounding district. The specimens sent were nearly full-grown, and were more characteristically Turnip grub, that is, larvæ of the *Agrotis segetum*, than can be certainly said of many Surface Caterpillars sent me, in the condition to which, without careful packing, they are almost sure to be reduced by a journey in unnatural surroundings, and possibly without vegetable food.

The figure at p. 54 represents the very common kind popularly known as the Turnip or Dart Moth, and its caterpillar, and, so far as could be judged, most of the specimens sent were of this species, scientifically, the *Agrotis segetum.* The kind figured below is often almost indistinguishable from the above in larval, that is, caterpillar state. It has the popular name of the Heart and Dart Moth, and, as often mentioned before, the two kinds closely resemble each other in their habits. The common method of life is for the caterpillars to feed at the roots of almost any kind of crop, though by preference at succulent roots, as Turnip, or at Potatoes, or Mangolds. During winter weather, and their conditions permitting, they may continue feeding, or may pass it in cells in the earth. On the return of mild weather, such caterpillars as have survived come out again to feed, and presently turn to chrysalids at or near the surface of the soil, from which the moths appear in due course, and lay their eggs during the summer, as early as June, or towards autumn.



AGROTIS EXCLAMATIONIS.—1, Heart and Dart Moth; 2, caterpillar; 3 and 4, chrysalis in earth-cell.

We are still apparently no further advanced towards finding a remedy for this destruction, but in the above observations we have one note of the plan of hand-picking, which appears to be the only really practicable method of clearing out this pest, being adopted. We have also a note, on the good authority of Mr. Thos. Collins, of adoption of the plan of hoeing as a means of getting rid of a proportion of the pests. The notes of failure of various dressing to do good, I have not thought it necessary to go into again; but the observation at p. 58 of the caterpillars seeming to be very materially reduced after a heavy night's rain, is worth notice.

It has been a well-observed fact that sometimes caterpillar prevalence has been checked by sudden rain in hot weather, the result being that the contents of the caterpillar are voided, and the creatures perish.

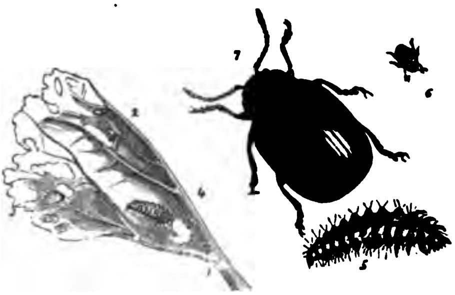
It is not apparently feasible to apply this treatment for field use, but in garden cultivation, where there is a plentiful supply of water, and a hose, something might be done to carry out the principle. But with regard to "Surface Caterpillars," their history, and the need of more practicable methods of getting rid of their destructive presence, is so well before agriculturists, both here and in America, that I have only alluded to the subject again this year in connection with the unusual extent of observation of prevalence of their attack to Mangolds.

Surface Caterpillars at roots of young Conifers.—The following note, sent me on November 9th, by Mr. F. O. Solomon, Lecturer in Agriculture at the Durham College of Science, Newcastle-on-Tyne, gives an interesting observation of the omnivorous propensities of the "Surface Caterpillars," which, in the absence of such food as they may especially prefer, appear, as has been occasionally remarked of them, to attack any kind of root that their jaws can bite into.

Mr. Solomon observed:—"What pests the Turnip grubs have been this year! We have at the College a small plot (thirty-three square yards) planted with Conifer seedlings. The little plants have been eaten off close to the ground. We could not imagine what was doing the damage for some time, but when we scraped about for grubs, we collected sixty-six on the thirty-three square yards in a very short time. They are most omnivorous feeders certainly."

MUSTARD.

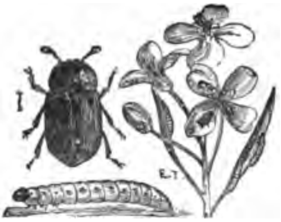
Mustard Beetle. *Phædon betulæ*, Linn.



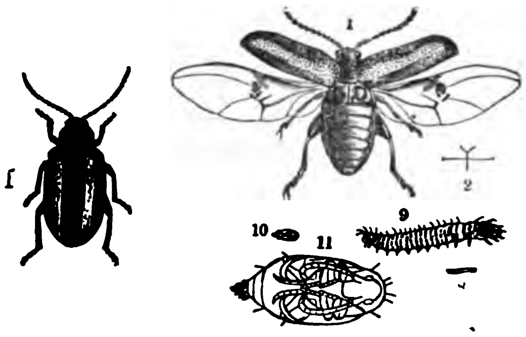
Phædon betulæ.—Mustard Beetle, nat. size and magnified; maggot, magnified, and nat. size on leaf.

For some years back, injury by insect attack to the Mustard crop has become so manifestly a matter requiring attention, that early in the past season much consideration was devoted, and consultation took place, as to what could be done, not only amongst Mustard growers, but amongst those also cognizant of the needs of the case from being, in various ways, interested in results of the Mustard crop.

As one obviously important point was circulating all available information, a four-page leaflet was issued by Messrs. J. and J. Colman, of The Carrow Works, Norwich, embodying useful, straightforward observations on the appearance and habits of the "Mustard Beetle," and of the "Turnip-flower Beetle" (*Meligethes æneus*), which sometimes is not far behind the Mustard Beetle in the damage it causes, these notes being accompanied by figures of the insects, and suggestions as to measures of prevention and remedy.

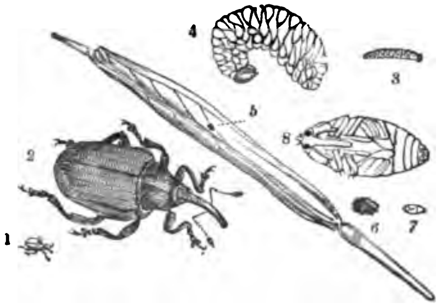


MELIGETHES ÆNEUS.—Beetle and maggot, magnified, and infested flower, and line showing nat. size of beetle, after Dr. Taschenberg.



PHYLLOTRETA NEMORUM.—Beetle flying, and at rest; maggot and chrysalis; all magnified, and with nat. size.

Much about the same time, as I found that there was a good deal of uncertainty abroad as to distinguishing various kinds of Mustard attack, I also issued a leaflet for distribution, with figures of four of the most destructive of the common kinds of infestation, namely, the Mustard Beetle, figured at p. 60; the Turnip "Fly," or Flea Beetle (figured above), which is sometimes a bad Mustard pest; also the Turnip "Flower Beetle" (figured above), a most serious infestation; and the Turnip-seed Weevil (figured at p. 62), a very minute beetle, easily distinguishable (with the help of a magnifying-glass) from the above-mentioned kinds, both by its shape and colour. This very little beetle is greyish in colour, and furnished with a long curved snout, or proboscis, and is very nearly allied to the little weevil which did a good deal of harm last season to Mustard plants just when they were first sprouting. Of this, the *Ceutorhynchus contractus*, some notes are given separately under the heading of its special name further on.



CEUTORHYNCHUS ASSIMILIS.—1 and 2, beetle; 3 and 4, maggot; 7 and 8, pupa; all nat. size and magnified; 5, infested Turnip pod.

The history of the Mustard Beetle has been so often given that it seems almost unnecessary to repeat it. Still to save reference I note it again as condensed into as short space as possible in my leaflet above mentioned.

The Mustard Beetle is of a deep full blue or greenish colour above (so shiny as to be almost of a glassy lustre), and black beneath. The legs and horns are also black. It is oblong-oval in shape, about the sixth of an inch long, slightly punctured on the back, *and has two wings.*

The grubs, which are of the shape figured at p. 60, are about a quarter of an inch in length when full-grown, slightly hairy, of a smoky colour, spotted with black, with black head, and stout black conical horns, lighter at the base. They have three pairs of claw-feet, and a sucker-foot at the end of the tail, and along the sides of the body are a row of tubercles, from which the grubs have the power of protruding a yellow gland.

The method of life is for the beetles to winter in any convenient shelter, in the most various kinds of localities. It may be in the ends of Mustard stocks, or in the roots of old Mustard plants left on the land, or in rough shelters made of Mustard straw; in ditch or hedge-banks, in the earth or in the rough grass, or at the bottom of hedgerows. Also they are to be found in crannies of walls, gateposts, old wood or bark, and are especially noted as fond of sheltering amongst the reeds and rushes, by ditches and drains; in fact, in any available shelter.

From these winter quarters the beetles come out in spring, and spread to any food-plant near, and especially amongst wild plants, to Cresses or Charlock, or to others which, like Cabbage, Turnip, or Mustard, are of the cruciferous kind. These various plants serve the beetles for a place for their egg-laying until the Mustard is ready, consequently to clear what may be called the *nurseries* of the year's attack, as well as to prevent, so far as may be reasonably possible, winter shelters being left for the parent beetles, are respectively methods of lessening coming attack.

On these food-plants the beetles which have lived through the winter lay their small eggs, and then they die. The grubs feed voraciously until they are full-grown, when they go down into the earth to turn to chrysalids. From these the summer brood of beetles come out in about a fortnight (it may be more or less), and these start new attack, and thus the infestation goes on, which may continue until quite late in the autumn.

With the history of the Turnip Flea Beetle we are all fairly acquainted.

The Seed Weevil destroys the seeds in the pods of various plants of the Cabbage tribe, and is sometimes found in flowering heads of Mustard.

But of these infestations the worst, excepting the "Mustard Beetle" itself, is that of the *Meligethes*, the Turnip-blossom Beetle. This I had the opportunity of studying the life-history of, on Rape or Cabbage, some years ago, in full detail day by day, and in all conditions, from deposit of the egg by a great infestation of beetles, to the descent of the grubs into the ground for change to the chrysalis state, and in the course of observation the destructiveness of their operations to the buds and flowers, and, as the grubs grew larger, to the neighbouring stems was exceedingly noticeable.

Its life-history may be shortly given thus:—When the Mustard plant is knotting for flower, the opening buds and blossoms are very often attacked by the "Turnip-blossom Beetle," the *Meligethes æneus*. This is of much the same shape as the "Mustard Beetle," but rather smaller, and of a duller or more brassy green. The eggs are inserted by the beetles in the buds; the grubs which hatch from these are whitish, with broad purple head, and some purplish markings, and when full-grown are yellowish white. They feed on various parts of the flower, especially at the base, and further on do harm by feeding on the upper part of the flower-stalk, and the outside of the seed-pods. Soon afterwards the grubs fall to the ground, bury themselves, and turn to chrysalids in the ground. This attack appears to me to rank in destructive power next after the true Mustard Beetles, and to be very often not distinguished from it.*

With regard to these, the *Phædon betulæ*, as I am not aware of the method of deposit of the eggs, and hatching out of the larvæ, being generally known, I add the following details from my own observations.

On the 2nd of June, a very good supply of Mustard leaves, on which eggs of the Mustard Beetle, *Phædon betulæ*, had been deposited, were sent me by request of Messrs. J. and J. Colman, of Carrow Works, Norwich, from Littleport Bridge, near Ely, per favour of Mr. Smith Flanders, for examination as to possible effects on the eggs of a dressing which had been applied five days before. The leaves were sent me tied up in two bunches, one bunch consisting of the leaves which had been dressed, the other bunch (duly distinguished and sent for comparison of condition of the eggs) of leaves to which no dressing had been applied.

These leaves I placed with the tips of their stalks in water, in a room of ordinary temperature, but two days later (on June 5th), as the eggs were unaltered in appearance, I moved the leaves to a room with a south aspect, where a window was open close to them during most of the day.

The eggs were smooth, cylindrical, and blunt at the ends, and yellow in colour; and for the most part were placed longitudinally by the side of the mid-vein, or one of the side veins, on the back of the leaf. They were very rarely indeed not placed by a vein, and (as far as I saw) never on the upper side of the leaves. They were placed in a little hollowed-out space, so that the egg rested in the substance of the leaf, against the inside of the upper skin of the leaf, and they were usually (although not invariably) covered by what appeared to be dead and discoloured remains of the skin of the little patch of hollowed-out leafage in which they rested, but, any way, by some adherent and protective rubbish.

The eggs appeared to be in healthy condition, that is, bright, shiny, and plump (not shrivelled or discoloured) when I examined them shortly after receipt, but I could not find as yet any formation of the larva, or grub, then taking place within, excepting perhaps in a few instances, and on pricking them a yellow fluid ran out; it was not until the 7th of June that they began to hatch, and on the following day I was able to watch the emergence of the larva, and its changes of colour, in detail.

The shape and colour of the egg could now often be seen through the thin film of the upper coat of the leaf, which had been left remaining untouched when the egg was inserted from the other side in the little cavity formed for it, and this upper film was now in some instances beginning to split away.

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* The above note on the "Turnip-flower Beetle," as well as that on the "Mustard Beetle," I have given nearly verbatim from my leaflet above mentioned, of which I should be happy to offer copies to any applicant.—(E. A. O.)

The operation of hatching, or emergence of the grub from the egg, was very slowly performed. In the case of a larva which I observed in the act of coming out of the egg, and which was then about three-quarters emerged, it was precisely nineteen minutes before the operation was completed, and the little grub stood beside the empty egg. During hatching the grub was not of the smoky colour which it presently acquires, but of a bright orange-yellow, with the four black spots on the back of the second and third segments from the head showing very noticeably on the yellow ground colour. The colour gradually became duller, changing to dusky or smoky tints of orange or yellow, and about forty minutes after the time of its first appearance from the egg, the little black horns were observable, and the head and claw-feet were turning grey, and the larva was now able to move about readily, making use of its caudal sucker-foot to help it in progression. The other larvæ, which I was able to watch during or immediately after hatching, were similarly of an orange colour, and changed gradually to the first shades of the smoky grey colour, under which we know them only too well on the Mustard leafage.

The above-mentioned method of egg deposit, and then of covering over of the eggs by the Mustard Beetle, is worth notice, as in the first part we see how early in the attack (even before the maggots have hatched out of the egg) the health of the leafage is damaged by the preparations for their presence; and next that the covering placed over their eggs acts as a protection to them from the effects of the remedial dressings which we might otherwise have hoped would help to check the attack in embryo.

The plentiful supply of grubs which hatched from the eggs enabled me to experiment on the effect of "Paris-green" applied to them as a dry dusting, with the result that nearly all so dusted were dead on the following morning.

On June 9th, I chose a Mustard leaf infested by a large number of the Mustard Beetle larvæ, which had begun to hatch on it two or three days before. This I dusted as lightly as I could with Paris-green by holding the leaf upright, and throwing a little of the powder taken up between my fingers and thumb at it, so that the under side of the leaf, on which the maggots were dispersed, was for the most part just faintly or hardly perceptibly tinted by it. In a few parts only there was a little patch where the powder was noticeable. This was a little before 6 p.m., and on the following morning, on examination of what had resulted at 9 a.m., I found that, with the exception of three of the grubs, all that had been hatched when the Paris-green was powdered on the leaf were dead. Of these, fourteen were still adhering to the leaf, others had fallen on to the saucer, and some into the film of water in which the tip of the stem of the Mustard leaf had been placed to keep it fresh so that there might be no question as to the larvæ not dying from want of food, rather than poisoning. Altogether the quantity killed as above was about eight and forty.

As the foregoing notes refer to specimens placed in my hand relatively to the early stages of attack, and also to experiment, which the liberal supply of material enabled me to carry out, I have placed these together before entering on the reports or correspondence of the season.

Much correspondence took place in January; and on the 1st of February, Mr. H. L. Leonard, of Preston, Hull, forwarded me the following report of discussion of the subject at a meeting which he had recently attended, and which embodies many points useful for consideration or amplification, and therefore (with permission) I give it *in extenso*, excepting a few sentences not especially bearing on the business points of the matter:—

"I last week went to Peterboro' to a conference of the Cambridgeshire farmers *re* Mustard Beetle." . . . "They agree that the beetle comes out of its winter retreat as soon as the sun gets well out, that it goes to the young Mustard plant, and lives on the leaves; it lays its eggs under the leaf, the grub is then hatched and falls to the ground,* where it buries itself, and goes into the chrysalis state. The beetle then emerges, and attacks the plant again.

"They all agree that the seed must be drilled further apart in the rows, and *constantly* worked amongst by the *horse hoe*, which will turn up the chrysalids, and which the birds would eat. One grower has always drilled the rows two feet apart; he pays great attention, and is confident that when the beetle is knocked off the plant it will remain on the ground for days if it is sunny. The first dull day, however, they return to the plant. If this is really so, it is a very important matter. As a dressing with the Strawsonizer he has used paraffin and water in *equal* parts, which was very effective, and which did not injure the plant. I did not agree with this being my opinion on syringing my plants, but he assured me that he was correct, and said there was great difference between a syringe which would leave the liquid in drops, and a Strawsonizer which would leave simply a dew on the leaf. †

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* Mention is omitted here of the feeding of the grub intermediately between the date of hatching and when full-fed going down for the change to chrysalis state; this being known to all present, would obviously not need entering on.

† This is a very important difference, but does not necessarily need a "Strawsonizer" to carry it out. There are other different kinds of sprayers which will give the dew-like deposit.

"Mr. Young said he strongly supported Miss Ormerod in all her theories on the beetle. Said he top-dressed his Mustard with fish-bone manure, which drove off all the beetles, and they did not return till after rain came, which washed off the strong smell. This year the same gentleman is going to lay ridging tiles all round a field which he will sow with Mustard, and cover them with tar continuously. He knows the field is clear of beetle at present.

"Another grower said he had always found it better to sow Mustard seed where the beetle had been very numerous in the previous Mustard crop, than on a field which had not been previously infested. He had tried an experiment which he thought might be very advantageous if taken up by an experienced machinist. As I understood his idea, it was something like a large well-hollowed shovel on wheels, exactly the width between the rows, just touching the plant at either side; it is pushed on by a man, and the beetles drop into the shovel alive, and can then be burnt. This is very simple, and I think the idea could be worked out to great advantage.*

"All growers are agreed that tar is very much objected to by the beetle. One farmer noticed myriads of beetles crossing the road, and through the gateway into his Mustard field. He divided about an acre against the gate from the rest of the field with a broad streak of tar; every night he renewed the application, and saved all his crop, excepting where the beetles were, which of course was completely destroyed.

"Another large grower thinks the Mustard Beetle in *the early growth* of the plant is blamed for more than it does. He thinks that the ordinary Turnip Fly does an immense amount of damage."—(H. L. L.)

This is a very important point, to which it seems to me sufficient consideration is not generally given. Whilst forming my Report on Mustard Beetle for the Royal Agricultural Society in 1886, I received notes from various correspondents of the injury done to Mustard in the first growth by Turnip Fly, or Flea Beetle. Specimens were sent of the beetles, and of injured leafage, and the infestation was described as "a great trouble by eating the plant when it first comes up." Also, "scarcely a plant remains of the original sowing"; and again, another correspondent, who forwarded three different kinds of Flea Beetles, mentioned them as destroying the Mustard on that part of the field where the seed-bed was not properly prepared; but that they were not to be found elsewhere.

For this kind of attack probably Fisher Hobb's mixture, which is so serviceable as a remedy for Turnip Flea Beetle on young Turnips, would be

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* If no more efficient plan is made public before requirements of protection come round again, or if brought forward the implement should be too expensive for ordinary private purchase, it is to be hoped that the suggester of the above will have it worked into serviceable form.—Ed.

equally useful. This consists of one bushel of quick-lime, and one of gas-lime, six pounds of sulphur, and ten pounds of soot, well powdered and mixed together, and applied WHEN THE DEW IS ON. *The above amount is sufficient to dress about two acres of young Turnips,—the precise quantity needed would depend on size of plant, and distance between the rows.—Ed.*

Mr. Leonard continued his report of the discussion as follows:—

"It was generally agreed that the most damage is done the fortnight before cutting the crop, when it is not possible to get amongst it. It is therefore of the greatest importance that the first lot of beetles in the spring be destroyed as much as possible.

"It was also agreed that the beetle prefers white Mustard to brown, and then Rape after the brown. One grower says that the beetle will lay its eggs on Mustard, and a few on Rape; but that though it may feed on Swede Turnips, it will not breed there. If there is no Mustard or Rape in a district, the beetle will die out, because no eggs will be laid. Most growers were agreed that the best thing to do would be to cease growing Mustard seed in badly infested districts; but it was found to be impossible to get the farmers all of one mind. One grower suggested that Messrs. Colman & Keen should refuse to buy seed from an infested district for five years, but it was pointed out that there was nothing to prevent speculators from buying it.

"It was not thought that many beetles remained in the straw. From the evidence, it strikes me that the most important thing to do is to gather up and burn the stubble, into which nearly all the beetles collect after the crop is cleared. As the stubble is green for some time after cutting, it would not break off by being rolled, and I cannot see how it could be done otherwise; it would not burn as it stands in the ground. A grass reaper might probably cut up a good lot, but not all."—(Signed H. L. LEONARD.)

Some other observations bearing more generally on prevention of attack were added, and also a few enquiries, to which I replied at the time; but it will be seen that the above notes give many points of serviceable interest, both for present information, and as leading to further enquiry.

Consultations were held, and suggestions and leaflets issued, and arrangements made in various quarters for field experiment as to practicable means of getting rid of the Mustard Beetle; but so far as appears from reports received, weather or other circumstances so influenced amount of this special pest, that though it (the *Phædon betulæ*), and its ally in causing damage, the Flower Beetle, did mischief in various places, there was not the sweeping devastation which in some years makes those interested willing to try any reasonable plan of remedy.

Later on the beetles appeared in vast numbers in one district. On the 23rd of September, Mr. Leonard wrote me again as follows:—"I am able to say now that there are an immense quantity of beetles in the Holderness district, and yet with the exception of about half an acre in one field, and the headland in another, which are completely destroyed, I cannot find any damage is done." Very possibly there may be opportunity in this greatly infested district for experiment next year; but at present, that is, in the past season, we do not seem to have made advance, at least to any notable and publicly announced extent, in knowledge of benefit from dressings, washes, and the like. Some of the soft-soap mixtures, which, from their success on very similar attacks, I had hoped might be of use, turned out, though tried with much care, a total failure.

With regard to preventive treatment, or to treatment calculated to push the crop on, and support it when attack is not absolutely overwhelming, it seems to me but a due respect to our Mustard growers to point out that a very large proportion of the really sound and valuable information now dispersed in leaflets, pamphlets, &c., was originally, and not long ago, *contributed by themselves.* In 1886, when attention was especially directed to the losses occurring from attack of Mustard Beetle, information was requested by the Council of the Royal Agricultural Society, and, as being then entomologist of the Society, I received much communication, which I formed into a Report printed in abstract in the 'Journal' of the Royal Agricultural Society, 1887, and in full in my own 'Annual Report of Observations of Injurious Insects' for 1886.

In these Reports will be found the first-rate information given by our leading Mustard growers themselves, as the result of their long experience, on such points as winter-locality of the pests, also the treatment of ground to start and keep up good growth, manures found especially effective, and many other points bearing both on the habits of the beetles, and agricultural points to be attended to, and also the *very little* benefit that was found to be derived from dressings was entered on.

For those who have not access to the information *in extenso*, the very excellent four-page leaflet, or circular, issued by Messrs. Colman, of the Carrow Works, Norwich, may be strongly recommended as embodying, in condensed form, an enormous amount of sound information, and also much useful suggestion, amongst which are some serviceable observations on drilling Mustard twelve to twenty-four inches wide, so that the ground can be horse-hoed so long as the hoe can be taken through the crop without damage. Thus besides other good effects, many of the beetles can be knocked off, and the chrysalids thrown open in the disturbed ground to be preyed on by birds. Also dressings which otherwise could not be applied, may thus be thrown on the crop without injury to it by breaking it down.

This is such a very important consideration that it deserves special notice, for in 1886, when through the courtesy of the late Prof. Herbert Little, of Coldham Hall, Wisbech, and Mr. William Little, of Stag's Holt, March, I had the opportunity of personally examining some of the Cambridgeshire Mustard crops relatively to feasible methods of clearing the beetle, the closeness of the Mustard plants was considered to make such measures impracticable.

The circular of Messrs. Colman includes also some serviceable observations on the "Flower Beetle" (the *Meligethes æneus*), together with figures of this and the common Mustard Beetle. The circular was largely distributed gratuitously last spring, and probably would be obtainable still through the courtesy of Messrs. Colman on application to themselves.*

During the past season, a really surprising number of mixtures, or powders for dressings, and sprayings to be applied by various forms of implements, were suggested for experiment, but of most of these (if tried) we still need to know results. Some, as mentioned above, were tried and failed. One class of application, however, I should myself have great hope would be successful, namely, Paris-green. In such limited and mere laboratory experiment as I was able to try myself (see p. 65), it answered excellently in poisoning the Mustard Beetle grubs, and from the very near relationship of our Mustard Beetle to the Colorado Beetle of America (both being Chrysomelidæ), there would appear to be every reason to hope that Paris-green, which has so long been a general accepted method in America of clearing the Colorado Potato Beetle, should be equally serviceable here.

But whatever might or might not occur as to possibility of clearing the Mustard Beetles by application of dressings, a very important advance towards a method of keeping them in check was made last season in the invention, by Mr. Cole Ambrose, of Stuntney Hall, near Ely, of a machine suitable for field use, which proved on trial excellently successful.

Of this, Mr. H. L. Leonard, of Hull, who, with other gentlemen personally interested in Mustard growing, or connected with our chief Mustard manufacturing firms, were present at a field trial of the machine, wrote me as follows regarding the apparatus as it then was. Since then gradual alterations and improvements have been made, especially in the arrangements for brushing the plant, which I can say from my own personal examination of the details of the machine must add much to its efficiency.

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* 'The Mustard Beetle,' a four-page circular issued by Messrs. J. and J. Colman, 108, Cannon Street, London, E.C.; and Carrow Works, Norwich. Coincidently with Messrs. Colman's circular, I also issued a four-page leaflet, of which I should be happy to send copies gratuitously to any applicant. But this was on a much smaller scale, being more especially intended to place figures of the four common Mustard pests (given above at pp. 60—62) in the hands of those who might have difficulty in distinguishing the different kinds of insects.

Mr. H. L. Leonard wrote me on the 17th of August:—"Through the kindness of the inventor, Mr. Cole Ambrose, Stuntney Hall, Ely, I was permitted to witness the working of a machine for catching the Mustard Beetles. I should describe the framework as similar to that of a horse-rake without the teeth; from the top bar hang five shallow pans about two feet six inches long, two inches deep, and made the same width as the Mustard seed rows are drilled apart. The pans just clear the ground, and in each is placed about an inch of common tar. Some light pieces of wood are so placed that they lightly brush the plant as the machine moves along, and almost every beetle drops into the tar and perishes.

"Nothing could be more successful in its work than this beetle-catcher; it is so very simple that it cannot get out of order, a pony pulls it, a man and a boy are sufficient to go with it; it goes over about twenty acres a day, and it does not injure the plant in any way, even when it is coming into flower.

"It has not been in the hands of the general public yet; but Mr. Cole Ambrose has two hundred acres of beautiful Mustard seed, whilst his neighbours have had their crop destroyed. The machine catches the *Phædon betulæ* and the *Meligethes æneus* equally well."—(H. L. L.)

The following report of his views as to the serviceableness of this beetle clearing machine was also sent me by Mr. James Egar, of The Rookery, Guyhirn, Wisbech, on the 8th of August:—"MUSTARD BEETLE.—A machine has been invented, and very successful for collecting them, by Mr. Cole Ambrose, Ely. I was invited by Messrs. Keen & Co., Mustard crushers, to inspect it at work on Mr. Ambrose's farm, and found it work admirably. Very efficient in its collection of the pest; it proved itself so in two ways,—leaving no beetles on the Mustard, and almost an innumerable lot on the emptying places at end of field."

About a week later, Mr. Egar wrote further:—"The invention I mentioned for taking the Mustard Beetle, I am confident is a very valuable machine"; and Mr. Egar further noted, amongst observation of the examiners of the trial operations:—"Firstly, of the presence of the beetles on the Mustard; then of the thorough clearance of the beetles from the crop; and thirdly, the 'immense number' found in the composition for catching them."

On the 22nd of November, Mr. Ambrose, as I was not able conveniently to go over to Ely to examine the machine, was good enough to bring over a sample of an improved form in pieces, and have it put together for my inspection here.

This operation only occupied about an hour and a quarter. The moving power and framework of the machine consists of a single pair of wheels (on which the machine rests), with what may be described as two small pairs of shafts, or large handles, one pair pointing forwards, and another backwards, joined in the middle by a frame, *across* which are fixed two long bars.

It is difficult to convey an idea of machinery by simple description, but if the reader will imagine a frame made on the general plan of a garden hand carrying barrow, with its handles behind and before, and instead of the carrying boards in the middle, the centre crossed by two light bars about seven feet long, and this frame supported on a pair of wheels; this will give (excepting in the machine being much larger than the barrow) a general idea of the frame from which the beetle clearing apparatus is suspended.

This part consists of five flat metal troughs, twelve inches wide, four feet long, and about two inches deep, slung from the cross-bars, so as to hang about six, or rather more, inches from the ground, and of course ranging from back to front (*i. e.*, not cross-wise). When in use, a layer of tar is placed in these troughs. On either side of each trough, and hanging from above, so that the lower edge is rather above it, a piece of canvas, somewhat longer than the trough, and a yard deep, is lightly slung (by a wand run in its upper edge) to the cross-bars.

The method of action is for the machine, which is very light, to be drawn or pushed along the rows of infested Mustard. One long trough passes between two rows, and the canvas on each side passes along with it *outside* the two rows, the apparatus being so contrived that the light touch of the canvas does not injure the plants, but very gently bends them a little over the trough below, into which the beetles fall in legions, and are caught by the tar. The machine is made for the suspending horizontal frame to range about four feet from the ground, but it is furnished with upright screw standards, by which it can be raised to allow a crop at ordinary full growth to be cleared. One important part of the arrangement is the slinging of the apparatus, which is so managed by short chains that no force is used; the strips of hanging canvas are in constant vibration, thus very lightly shaking the plants, but not *weighting* them, as their own light weight is slung from the bars. Each trough, with its shaking-off canvases, takes two rows of Mustard, consequently the machine with five parallel troughs would clear ten rows of Mustard simultaneously, and it will clear from sixteen to twenty acres in the course of the day.

The main alterations of the machine since the inspection in August, consist in it being so arranged that it is not necessary for it to be drawn by a pony, which might probably cause a good many beetles to be knocked off before the sweeping and catching apparatus reached them, and also, I believe, the shaking-down arrangements were not then as complete. On flat ground, without obstructions, the machine was very readily pushed along rapidly by one man, and where greater power is needed (with the double shafts), it can be arranged for accordingly. On reaching the ends of the Mustard rows, the machine being very light can (as I saw) easily be lifted by two men, moved on to the next width of rows to be dressed, and work recommenced, without any need to turn it, as it works similarly either way forward.

In thus drawing attention in long detail to this new invention, I should perhaps add that I am doing it by desire of some of our leading Mustard growers, and also with the full permission of Mr. Ambrose; but I should also mention that though giving the principle of action, and enough description to show its usefulness, I have (or at least I hope I have) in no way entered on details which would make this a means of copying the machine to the injury of its *inventor and proprietor*. Its *effectiveness* and its *safe* action on the crop depend on minute adaptations, causing special movements which I have purposely omitted entering on.

In this machine I think we have the broadscale application of the plan long ago brought forward in Germany of clearing the beetles by manual labour, which has been acted on here to some degree, but as far as I am aware very rarely, on account of the great expense, and also the tedious delay of the operation. The only difficulty that occurs to me in the general application of the machine, is the necessity that the Mustard should be a drilled, *not* a broad-casted, crop. But this would be only an occasional difficulty.

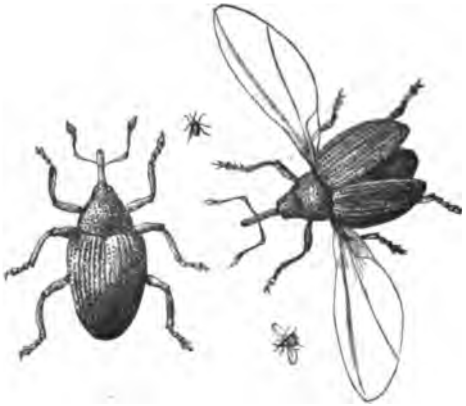
Also in its working application it is to be remembered that its use is to get rid of the *beetles*. It will equally well clear the Mustard Beetles, or the Flower Beetles (which are not far behind them in the mischief which they cause), and if this is done in time, the damage going forward by the beetle action will be put a stop to, and also we shall be saved from the next attack, which would have originated from the grubs hatched from the eggs these beetles would have laid. But if the attack should not be taken in time, though we should get rid of beetles, very likely much of their supply of eggs would have been laid, and their results would in due season ravage as usual.

In this machine I believe, partly from my own inspection of it, partly from the reports sent me by known Mustard growers, and also partly from it working forward on a field-scale-treatment which we knew was good, but could not work forward by hand labour on account of its great expense, that we have a good working remedy.

Doubtless amount of attack might be lessened by preventive measures, but everybody who is really acquainted with farming will know how little likely it is that money will be spent, and farm service taken up in preparations for an infestation which it is just as likely as not might not be going to occur in the next season.

What we want here (as in many other attacks) is something on the farm, or at hand for a neighbourhood, which may be put in working order in a few hours or less when the pest is really seen to be on the crop, and which may be trusted to clear it at once, without damage to the plant, and, as far as I can form an opinion on the matter, in this machine we have it.

Charlock Weevil.* *Ceutorhynchus contractus*, Marsh.



CEUTORHYNCHUS CONTRACTUS.—In usual position, and also with wings expanded, magnified; also nat. size.

The little weevil figured above did a great deal of harm early in last season to the young sprouting Mustard plants by preying on the germinating seed, or on the young plant just below the surface of the ground.

This *Ceutorhynchus contractus* is very like the well-known Turnip-gall Weevil, also the Seed Weevil figured at p. 62; like them it is of a hard rounded general figure, blunt behind, and tapering before into a long curved proboscis, or snout, on the sides of which the elbowed

* I am not aware of this little beetle being known under any generally accepted English name, but in the Index to Curtis' 'Farm Insects,' at p. 519, there is a single reference to it as the "Charlock-seed Weevil." Therefore, as the name of "Charlock Weevil" would include the root-galls (from which we have scientific record of this weevil being bred) as well as other parts of the plants, I have thought this name conveniently admissible.

antennæ, or horns, are placed. It may, however, be to some degree distinguished from these by its smaller size, this being only about half to three-quarters of a line in length, whilst the stated length of the Turnip-gall Weevil is one line and a third, and that of the Seed Weevil from one line to a line and a quarter. The general tint is shiny black; the wing-cases sometimes (and in some of the specimens before me) having a very slight greenish glance, and the fore body, or thorax, which is narrowed (and crossed by a deep groove) at the end nearest the head, is strongly punctured above. The wings are so finely nerved that even with a two-inch objective, I could only distinguish those figured.

On the 10th of May, Mr. H. L. Leonard, of Preston, Hull, with whom I had been in correspondence for some months previously on the subject of Mustard attacks, was good enough to forward me the following report of his personal observations of the mischief then being caused by the ravages of this little beetle:—"I have just finished my round amongst the Holderness growers of white Mustard seed. I find a great amount of damage has been done by a small weevil, which is present in immense numbers, and of which I send you specimens. Owing to the heavy rain on March 1st, and the subsequent long drought, the soil is in small clods, instead of being, as should be the case, well pulverised, yet firm.

"Just before the plant shows itself above ground, the weevil (which through the unusual state of the soil is enabled to run under the surface easily) eats the seed, and in doing so of course destroys the young plant itself, nothing being left but the thin sprout, which quickly dies. Virtually, every seed is destroyed in some fields, and they have had to be sown over again. As a proof that the weevil would probably be innocuous but for the exceptional condition of the soil, I notice that in the worst infested fields, when a piece of land is in fine condition, you find the plant upon it quite healthy, and growing well.

"On some fields the plant has been eaten off after it appears above ground, but in all these cases the plant *was delicate and growing badly*, and *both the weevil and the Turnip Fly* were present in large numbers. The farmers generally think the weevil the most destructive of the two." Later on (Mr. Leonard mentioned), "The weevil completely disappeared in about three weeks or a month."

On June 7th, Mr. Leonard again alluded to the great extent to which he found amount of attack was influenced by condition of the land, and consequent condition of the plants "wherever the land had worked more freely, and the Mustard was growing more vigorously, there you scarcely find any of the weevil. The more delicate the plant, the greater the number of insects.

"Several of the farmers are quite certain that where the plant was eaten off above ground, the damage was done by this same weevil. I enclose you some live specimens of the weevil, and also some sprouts which have been eaten in the ground; I am afraid the latter will be too shrivelled to be of any service to you."

The little seedling plants were too shrivelled to be useful for figuring, but they well confirmed Mr. Leonard's account of the damage caused to the very young plants by being gnawed by the weevils, and the plentiful supply of the weevils, sent accompanying, gave me material for the figures at the head of this paper.

In the course of his communications, Mr. Leonard mentioned that a large quantity of seed had passed through his hands in the spring, but he had not seen one weevil amongst it; and, after the great ravage alluded to above, this *C. contractus*, sometimes known formerly as the "Charlock-seed Weevil," appears to have entirely vanished. On the 5th of August, Mr. Leonard, in continuation of his observations, noted:—"The weevil, as I reported, did a great deal of damage where the plant was checked in its growth by drought, and in several fields, where the same insect had eaten off the young plant just under the surface, the crop had to be sown over again; but in no case have I had it reported to me that the weevil appeared a second time; in fact, the second sowing of Mustard seed looks very well.

"The weevil seemed entirely to disappear in a few days, *during which we had no rain.* I was asked to examine a field which was very badly infested; ten days afterwards I could not find a single specimen."

On the 11th of November, Mr. Leonard further noted:—"Our second sowing of Mustard seed has done fairly well, and in *no case* has any perceptible damage been done to it by the weevil, in fact I have never noticed one since the first attack."

Some notes sent me on the 26th of May, by Mr. Edmund Riley, of The Weir, Hessle, Hull, obviously refer to this *Ceutorhynchus contractus* presence:—"I was in Hull on Tuesday; several of the Sunk Island farmers complain bitterly about something eating their Mustard just before it comes up, that is, as soon as it has burst through the skin; the two delicate leaves are eaten, and the seedling dies."

The only previous occasion recorded (so far as I am aware of) of this weevil doing serious damage was in 1881, the year memorable for the great Turnip Flea Beetle attack, which was little less than a scourge over a great part of England and Scotland. In that year this *Ceutorhynchus contractus* (the Charlock or Charlock-seed Weevil) was reported as doing much damage to young Turnips in their first growth, and also (which may be an important point in its habits for preventive service) when the Turnips were cleared, going on to Charlock, sometimes known in Scotland as "Runches," or "Skellocks," and scientifically as the *Sinapis arvensis*, Linn. The method of injury was of much the same kind which has been observed in the past season on the Mustard, the plant being in some cases "destroyed by the weevil nipping the stem through just below the seed leaves as they were pushing up out of the earth." In another instance (where the first sowing of young Turnips, and then the Charlock, had been cleared by the weevils) resowing "was begun on the 17th of June by passing the Turnip sower over the drills, the ground being clean and mellow; the plants came up rapidly, and just as they were coming through they were again attacked by the weevils, the leaves being literally blackened by the numbers of the insects, the parts of the field where the Charlock was most abundant during the preceding season being the first to fail before the attack, and being soon cleared; and from these spots the weevils gradually extended their ravages, and again ruined the crop."*

The weevils in these attacks did not limit their ravages to damage to the sprouting plant, but if it survived (or chanced to escape) infestation up to production of seed-leaves, these were severely injured or destroyed, "the weevil puncturing the leaves partly through, both from above and below, so badly, that on one seed-leaf, taken as an example of the many," I found, on examination, "there were twenty-two punctures (not perforations) on the upper side, and about sixteen on the lower." In the ten days preceding the 8th of June it was more injurious even than the Turnip Fly, and hundreds of acres are reported as having been destroyed by it; dry weather occurring at the time in the district round Earlston (Berwickshire). These were resown with a double quantity of seed, and the insects reappearing, a second clearance was feared; but a good rain set in, and the plants came away well.†

The above attacks took place in coincidence with circumstances to check the growth of the young plants, as drought and heat, in one case noted as "intense heat" from the 22nd of May to the 4th of June, this heat being followed by frosty nights, accompanied by cold winds, which checked the plants to a serious extent, and in some instances completely destroyed them.

The above observations of the injury caused to leafage corresponds with the note given in 'Introduction to Entomology,' by Kirby and Spence, p. 188 of vol. i. of 3rd edition, as to "almost as much damage being sometimes occasioned by a little weevil, *Curculio*" (= *Ceutorhynchus*) "*contractus*, which in the same manner pierces a hole in the cuticle," as by the Turnip Flea Beetle.

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* 'Report of Observations of Injurious Insects for 1881,' by Eleanor A. Ormerod pp. 103—105.

† See Report previously quoted,

This Curtis confirms in his 'Farm Insects,' p. 106, on the authority also of other observers named, noting, "This little weevil in the perfect or beetle state destroys the young Turnips by puncturing the leaves."

But though we have plenty of evidence, dating as far back of the damage caused from time to time by these little weevils, the *Curculio*, now *Ceutorhynchus*, of Marsham, both to the sprouting shoot and young leafage of Turnips, and in the past season have seen only too much of the harm caused to the sprouting Mustard plants, yet I have been unable, after careful search through all the works to which I have access on entomology, or agricultural insects attacks, to find any observations on its locality of life in its maggot stage excepting the very valuable record by Kirby and Spence of breeding it from galls on Charlock roots.

At p. 189 of 'Introduction to Entomology,' vol. i., previously quoted, Kirby and Spence speak definitely of knobs on the roots of *Sinapis arvensis* (that is, Charlock, as we commonly call it in England), from which knobs they bred this weevil, now known as *Ceutorhynchus contractus*. Curtis, in 'Farm Insects,' p. 106, draws attention to this observation; and in the north British communications sent me in 1881, I have a note in the observations of Mr. Geo. Brown, of Watten Mains, Caithness, of "the crop of Oats preceding the root crop" (which was severely injured by the *C. contractus* weevil) being "badly infested with Charlock, the field at one time being completely yellow with its flowers."

Here it appears as if we might have the origin of the attack. At any rate it would be well worth while in the coming season to make sure how many different species of weevils live in the knobs or galls of Charlock roots. I would be happy to endeavour to identify any specimens.

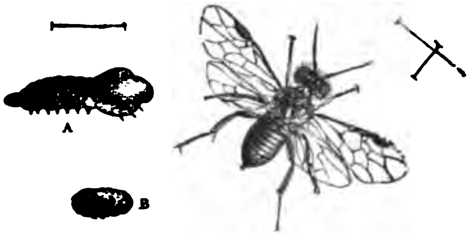
At present (so far as recorded observations at hand show) the prevalence of this special weevil infestation appears to depend very much on how *previous state* of the weather may have influenced preparation of the ground for the seed bed, and weather *at the time* of sprouting of the crop be favourable to its growth. Where the state of the land allows this minute beetle with its sharp hard snout to make its way wherever it pleases, and the weather at the same time keeps back the young plants from pushing on to the age and condition in which they would be past its power to harm them, the consequences are necessarily bad.

Presence of Charlock has also preceded bad attack of this weevil, and the size of its wings (see fig., p. 74) shows the beetle would have no difficulty in coming from any moderate distance to a good feeding-ground.

So far, however, as remedial measures have been tried, the result has been very unsatisfactory. Quick-lime strewed on four infested drills by way of experiment drove away some of the weevils, but "the remedy could not be said to be successful." Soot did little or no good, and hellebore was not reported as of service when used alone, but mixed with lime did the most good of the above applications. It was, however, noticed that where gas-lime had been used in the previous autumn the Turnip plants appeared less infested, and in a few instances got into the rough leaf.

PEAR.

Pear and Cherry Sawfly; "Slugworm." *Selandria atra*, Westwood; *Tenthredo cerasi*, Linn. (of Curtis); *Eriocampa limacina*, André.



TENTHREDO CERASI.—"Slugworm" and Sawfly, magnified, with lines showing nat. length; cocoon.

Amongst the various kinds of Sawfly attack which appeared in the past season, that of the larva of the Pear and Cherry Sawfly, commonly known from its very peculiar appearance as the Pear "Slugworm," was perhaps more noticed than usual, and some very characteristic specimens of the grub, both in its commonly observed slimy black condition, and in the subsequent clean yellow caterpillar state, were sent me. Some infested leaves gave me also the opportunity of noticing the earlier part of the attack, when the larva is still within the egg, and thus tracing the changes of appearance on from its first white colour to the pale yellowish tints of the young grubs in their early condition, before they assume the black slimy coating, from which they take their name of "Slugworm."

This infestation is sometimes exceedingly hurtful by the grubs eating away the whole of the upper surface of the leafage on which they feed with the exception of the veins, and sometimes they are very numerous. Often, however, where I have had the opportunity of observing them, the numbers have been small. This difference in amount is noticed by Mr. Cameron,* who (besides reference to their occasional appearance in great numbers, "as they unfortunately too often do") writes of their more ordinary infestation as follows:—"The larvæ feed on the upper side of the leaf, usually to the number of three or four. They eat only the upper epidermis; at first the leaf gets eaten in patches, but ultimately every particle of green is devoured, so that it has the appearance of having been scorched, and ultimately it falls to the ground." . . . "The damage done by these ugly brutes to fruit trees is very often immense; especially is this the case during very dry seasons. They are found on most species of *Pyrus*, *Prunus*, *Cerasus*, *Rubus*, and *Amygdalus*, as well as *Cratægus*, *Quercus*, and *Betula*."—(P. C.)

Of the above list, the three first, the Pear, Plum, and Cherry, are the most important for garden consideration, and it has never chanced to me to meet with them on the three last named, the Hawthorn, Oak, and Birch.

The grubs are, in the greater part of their lives, of the shape figured at p. 79, that is, both broader and thicker at the fore part of the body, and altogether somewhat pear-shaped, but covered with a shiny blackish slime, or exudation, which gives a strong resemblance to a little black Slug, or perhaps still more to a bit of wet black dirt fallen on the leaf. At the last moult the grubs throw off the black slimy coat, and appear as yellowish caterpillars transversely wrinkled. After this change they soon go down into the ground, where they spin small black or brown cocoons, from which (in ordinary course) the Sawflies come out early in the following summer.

The flies are of the shape figured at p. 79, black, shining, the female sometimes tinged with violet; the "wings hyaline, with a broad smoky band in the middle."

The first communication of last season regarding Slugworms was sent me on the 14th of June, from Neasham Hill, Darlington, by Mr. R. Cresswell Ward, with some Pear leaves accompanying, which gave me the opportunity of observing the young Sawfly maggot whilst still in the egg. Mr. Ward wrote:—"Can you tell me what is the insect enclosed? It appears to me to be a kind of black Slug. For the past three years it has come on my Pear trees about this time of year. It eats all the upper skin off the leaf, which turns brown and drops off; all the strength appears to go from the trees, which have hardly fruited since it began. I tried syringing with paraffin, water, also soap-suds, last year, and this year my gardener painted the stems and boughs with a mixture of sulphur, paraffin, soot, and gishurstine; but it has done no good. Can you suggest any way to stop the attack, both now, and in the future?"

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* See 'Mon. of the Brit. Phytophagous Hymenoptera,' by Peter Cameron, vol. i., p. 225. (Ray Society).

In reply I mentioned the benefit of use of caustic dressings (noted at p. 82), applied twice, or possibly three times, at short intervals, and on June 19th, Mr. Cresswell Ward wrote further regarding effect of the application on the Sawfly larvæ:—"My gardener has used the quick-lime, and it is killing them rapidly; and your other instructions will of course be carried out, and another year I have no doubt the trees will bear fruit." . . . "The heat is very intense; we all hope for rain."

Mr. Ward's note of the heat and drought is of special interest in connection with the information recorded by Mr. P. Cameron (*loc. cit.*, p. 80) of damage being especially great from these larvæ "during very dry seasons."

In this case the active stage of the attack to some of the leaves sent me was only just beginning, the upper surface of the leaf not being as yet stripped of the cuticle in patches, but dotted with little irregularly circular patches, some less than half a line in diameter.

The places of egg deposit were very observable. These were noticeable on the upper side of the leaf as little spots roundish in shape, and whitish in colour (from the upper coat of skin being dead), slightly raised in the middle, and of a somewhat transparent tint just over the contained egg, which was a soft mass, compressible, thick, and somewhat circular in outline.

Most of the larvæ had hatched out, leaving only the white skin cracked where the maggot had effected its escape, but two eggs still remained unhatched. One of these eggs contained the white Sawfly larva curled on itself within, and sufficiently developed to be of characteristic shape, that is, with the large segments behind the head, and the hinder portion of the maggot with the segments much narrower. In the other egg the contents were not yet sufficiently developed to be defined in shape. I did not see any larvæ in the act of coming out of the egg, but the smallest of them were as a general thing of a yellowish colour.

The little white blisters, or patches, of white dead skin covering the eggs were about one-sixteenth of an inch across, and one leaf, where I counted them, over thirty in number; on another there were about twenty-five; all these (with possibly one exception) showing on the upper surface of the leaf.

The latest observation sent me of this Pear leaf pest, was sent on the 28th of August, from Etchowe, Lansdown Road, Cheltenham, by Mr. Edward Cornford, and is of special interest as showing the long continuance of the attack.

Mr. Cornford wrote as follows, with specimens also forwarded:—"My Pear trees have been infested this year by larvæ of I know not what." . . . "They are shiny black, except when they are about to change into the chrysalis state, when they become a dirty yellow." . . . "The second brood is now *en evidence* about six weeks after the first; I think I have one pupa, but am not sure."

On the 31st of August, Mr. Cornford wrote further:—"I have not succeeded to any extent in getting many chrysalids, but have one or two which I think have made a sort of cocoon with fine saw-dust. But out of about twenty which I put to burrow when they seemed ripe, I have not as yet found more than two or three in the chrysalid form." Mr. Cornford further remarked of the grubs, "they are still appearing on the trees, from the smallest to the full-grown size, but the imago I have failed to find."

This (apparently) second appearance of brood is attributable to irregular date of pupation (*i. e.*, going into chrysalis state of the larvæ) in the preceding year, or to irregular development from this or other cause, of the Sawfly parents during the summer of attack. As a rule, there is only one brood in the year, though the appearance of the grubs, from various causes, may range over a period of three or four months.

A few days later, Mr. Cornford added the further note showing the great amount of the infestation:—"I did not want you to trouble yourself to return the box, &c. I have only too many specimens even now, though my gardener has spent no end of time in clearing, or trying to clear, the trees of the pests. Yesterday I found one specimen on a Plum tree."

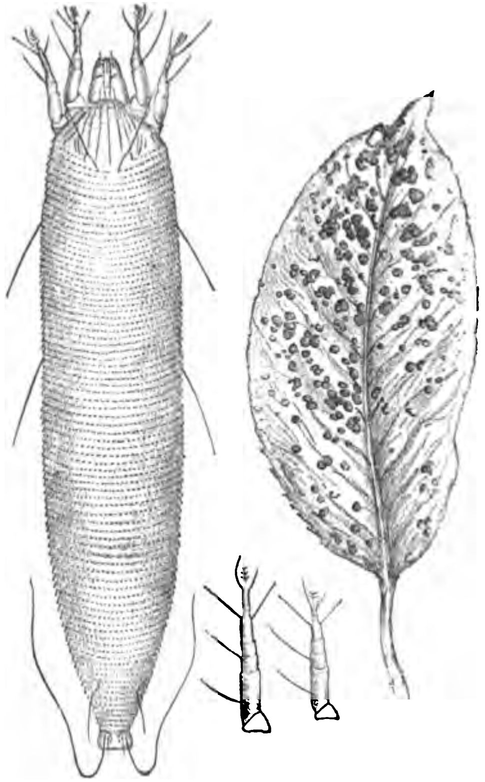
Prevention and Remedies.—These are based on two special points in the habits of the larvæ. These grubs, or "Slugworms," have a power of exuding a coat of slime when annoyed by lime, or other dry dressings, being thrown on them, but they can only repeat this process a few times, therefore if anything like lime, or powdered gas-lime, or a mixture of these is thrown on them, the grub can moult it off *once*, but a second application of it so soon after that the grub has freed itself of the coating, and yet has not had time to re-form the internal supply of slime to protect itself with, will probably completely clear the pests. If more than a few hours are allowed to elapse between the dressings, it is very likely that the second may fail; but if properly managed, two dressings are usually successful.

Syringings of the usual insecticides, as soap-suds, soft-soap mixtures, tobacco-water, lime-water, &c., have all been found useful in getting rid of the grubs; so also has shaking down the Sawflies. They have been found to remain for a short time motionless after being shaken off the tree, and if a time was chosen, as at morning or evening, when the flies were torpid, or collected on the leafage, and they were shaken down on tarred boards, something might thus be done to check mischief.

But besides dusting the grub with caustic powders mentioned above, the surest preventive measure is during winter to skim the surface off the soil beneath trees that have been infested in the summer, and to burn or otherwise destroy it. When the caterpillars are full-fed, they go down into the ground, and there form a little dark coloured cocoon (see fig., p. 79) at a depth of from one to four inches, according to the nature of the soil. With a very little attention, anyone (interested in preserving the crops of Pears) will soon detect the little earthy coloured cocoons containing the caterpillar, or later on, the chrysalis to which it has turned, and from which, if undisturbed, the Sawflies would come out next year. *The ground must not be dug* so as to risk injury to surface rootage, but if lightly forked, or turned in any way which may just disturb the surface only, the cocoons might be hand-picked, or if found to lie close to the surface, this might be skimmed off, and in either way, if the cocoons are destroyed, much good will be done.

All of the above methods of prevention have been entered on in my previous observations of this attack, but as the infestation of the past year gave some amount of additional information beyond what is usually brought forward as to the early life-history of the insect, &c., the whole account would be incomplete if remedial measures were only referred to.

PHYTOPTIDÆ, commonly known as GALL MITES.—**Pear Leaf-blister Mites.** *Phytoptus pyri,* Nalepa; (*? Typhlodromus pyri,* Scheuten; *? Phytoptus pyri,* Pagenstecker); and other species.



PHYTOPTUS PYRI, female, nat. length circa 0·2 mm.; left leg of the first pair of *P. tristriatus,* and (smaller figure) of *P. tristriatus* var. *carinea,* magnified 550 times, all after Dr. Nalepa. Infested Pear leaf.

During the past year the presence of Mite Galls, that is, of the deformed growth caused by the minute cylindrical four-legged Mites, scientifically known as *Phytopti,* has been more than usually observable. Almost as soon as growth was sufficiently advanced for their formation, we had the red or green nail-like galls on the Maple and Sycamore leaves, and the swelled and stunted leaf-buds, caused by the Mites, on Nut bushes. The Black Currant bud-gall was a bad trouble; and we had besides the blister-like form which injures the substance of Pear leaves, the infestation which raises a kind of wall of little funnel-shaped knobs round the edge of Plum leaves, and the less observable bud-gall of the common Yew.

For many years, the life-history of the minute Mites, which give rise to the above and to many other forms of gall-growth, and still more their specific description has been (with regard to most of the attacks) a subject of exceeding difficulty. And, further, beyond a very preliminary diagnosis of characteristics, often equally applicable to a large proportion of our most common British *Phytopti*, we were for the most part without any work to turn to, from which (even with the help of the highest microscopic powers) we might trustworthily identify each species in full.

We were in the condition described by Dr. Löw, the eminent Austrian writer on this subject, when he remarked that even if he were to thoroughly examine the mites out of great numbers of the deformed plant-growths which he had described, still he would not be able to give such sufficient and trustworthy characteristics as would supply the power of specific distinction.

In fact (to put it shortly), what even the most scientific "Mite-gall" observers needed was something equivalent to a 'Manual,' containing fully detailed descriptions of the different species of the "Gall-mites," with measurements, magnified figures, and everything requisite for correct and *demonstrably* certain identification.

These now we have in the publications of Dr. Alfred Nalepa, which have been successively issued in the 'Reports of the Proceedings of the Imperial Academy of Science of Vienna.' During the past summer, Dr. Friedrich Thomas, of Ohrdruf, Gotha, himself a well-known phytopathologist, and observer and writer on Gall-growths, did me the favour to introduce me by letter, relatively to study of *Phytopti*, to Dr. Nalepa, then Professor in the Royal Imperial College, Linz-on-the-Danube, now of the Royal and Imperial Government College, Vienna.* Dr. Nalepa was good enough to identify for me all the specimens which I sent over, and also to give me valuable instruction as to the anatomical and structural formation of *Phytopti*.

In the works of which I give some of the titles appended to this paper, will be found a clear and convenient classification of the family *Phytoptidæ* into subfamilies and genera; the main distinctions turning on such points as the body being cylindrical, as is commonly the case with the genus *Phytoptus*, with which we are best acquainted here; or the abdomen being largest immediately behind the thoracic shield, or other variations of form; also on the abdomen being similarly ringed throughout, or with the rings broader on the back and narrower below, or other variations.

With the kind permission of Dr. Nalepa, I have given a copy of one of his very numerous and clearly drawn illustrations at the heading of this paper, by which the observer will see the cylindrical form, also the position of the bristles and the clearly-defined form of the legs, showing the distinct joints, and the characteristic subterminal feather-formed holding-claw (Haftklaue, Landois).*

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* Prof. an der K. K. Lehrer-Bildungsanstalt, Linz-u-Donau, Austria; now of K. K. Staats-gymnasium, Vienna.

For distinction of species, such characteristics as the form, and comparative length and breadth of body; form of thoracic shield; form, direction, and length of proboscis; characteristics of legs, and number of branches of the feather-claw; length, &c., of bristles, and length and breadth of developed males and females; are some of the points given. Very much more besides is clearly entered on, as for instance the change in form of the male of the Nut *Phytoptus* (*P. avellanæ*) at the time of sexual development, and the apparatus of reproduction is especially entered on, with measures and descriptions; the form of the egg is also given where known. Synonyms, or what might be synonyms if the names referred to had been accompanied by full description, are given; but as it is pointed out, names without full descriptions accompanying are unserviceable. In fact, "bare words" are, as was well said by Dr. Amerling, "of only temporary use as a means of reference, pending fuller description."

In the following pages I give (with permission) some abridged technical descriptions; but as it is hardly just and fair to the author of a work of such depth of research to place mere fragments of it before scientific readers, in translation and in abridged form, I append to the account of the Plum-leaf *Phytoptus* a copy in full of Dr. Nalepa's description, as an example of his careful and thorough method of dealing with his subject. Also I should be to blame if I did not tender my especial and hearty thanks for the kindness with which he aided me by his clear instructions in this difficult study.

PEAR-LEAF BLISTER-GALLS (*Phytoptus pyri*, Nalepa).—"Body cylindrical, about 5–6 times as long as broad. Thoracic shield very small, semicircular." . . . "The proboscis is strong, slightly curved, directed forward, and 0·025 mm. long. The legs are rather weak and short, but distinctly jointed. The bristles are very fine and short. The holding-claw ('Haftklaue') is very small, exceedingly slender, and four-branched." (This is sometimes described as a "feather-bristle"; see figs. of terminal four-branched claw, p. 84.—E. A. O.) . . . . "The abdomen is uniformly ringed (about eighty rings), and rather finely punctate." . . . . . . "The above-named species produces on the leaves of the *Pirus communis*, L., numerous pustule-formed swellings, somewhat raised on both sides of the leaf, smooth, at first green, afterwards turning browner." . . . . . (? *Typhlodromus pyri*, Scheuten; ? *Phytoptus pyri*, Pagenstecker.)*

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* For full description of *Phytopti*,—male, female, and eggs,—see 'Beitrage z. Syst. d. Phyt., in: Sitzgsb. d Kais. Akad. d Wiss. in Wien,' 1889. Bd. 981 (separate impression), pp. 8—10.

This Pear-leaf infestation is not often enquired about, but personally, for at least about sixteen years or more, I have never needed specimens without being able to find them in my own garden, and probably if attention was directed to the nature of the attack, a good deal of damage, of which the cause is not suspected, might be spared.

In the course of last year I had enquiries about this attack from various correspondents, but as these did not add to our information on the subject it is unnecessary to give them here.

Under various synonyms the infestation is widespread, both in the Old and New World; and the following notes, from the very trustworthy hand of Mr. James Fletcher, Dominion Entomologist, Ottawa, Canada, recently published, appear to me to embody in serviceable form almost all that we need to know of its history.

"PEAR-LEAF BLISTER MITE, *Phytoptus pyri*. An insect which is giving a considerable amount of trouble in Canada at the present time is the Pear-leaf Blister Mite." . . . . "The mites, which are hardly visible with the naked eye, emerge from the scales of the leaf-buds early in spring, and attack the tissues of the unfolding leaves. The blisters soon begin to show as small red spots, each of which has a small central hole on the lower side of the leaf. The eggs are laid inside these blisters, and the young, escaping through the central opening, at once form new galls, until sometimes the greater part of most of the leaves is rendered unfit to perform its functions.

"When mature the galls are brown and spongy in texture, and are raised perceptibly above the surface of the leaf. Before the leaves fall the mites leave the galls, and secrete themselves beneath the scales of the winter buds, where they remain throughout the winter.

"As a remedy, kerosine emulsion seems to be the only substance which, up to the present time, has given any promising results."—From "Report of the Ontario Fruit Grower's Association," p. 113, published in the 'Annual Report of the Department of Agriculture of Ontario for 1892.'

For those who do not care to be at the trouble of mixing the emulsion themselves, the very similar mixture sold in this country, under the name of "antipest," and especially referred to in the preceding paper on Gooseberry Red Spider, p. 87, would be found to have very nearly (or precisely) the same effects.

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* Nalepa, 'Zur system der Gallmilben,' Sitzgsbers, 1890, pp. [50, 51] 11, 12; plate iv., figs. 1, 2. See also references in 'Katalog. der bisher beschrieben Gallmilben,' by Dr. Nalepa, pp. 275 and 296.

Something, however, towards checking resettlement of the infestation might be done by syringing the leafage when the Gall-mites are wandering about. During last summer, Mr. W. Gibbon, of Seaford Grange, near Pershore, in a few remarks which he sent me on this Pear-leaf attack, mentioned that under microscopic investigation he found that these Mites were very similar in appearance to those of the Black Currant, "but more active."

Dr. E. L. Taschenberg says of them that the "sexually developed Mites move about fairly nimbly on the under side of the leaves. They are found throughout the whole year, from May onwards, of various ages, and have many broods, so that multiplication continues uninterruptedly until the winterly season. They disperse themselves, both as larvæ and developed Mites, in the leaf and flower-buds of the one-year old twigs, embedded in the felt-like layer of hairs on the inside of the outer bud-scales."* Dr. Taschenberg draws attention to the infestation having been found to begin its yearly course on the lower leaves of the twigs, whilst the upper are still free, and therefore points out that if these infested leaves are cleared it will greatly help to check attack, especially in nursery grounds.

In my own observations I have thought that syringing with soft-soap compounds on the leafage in summer was useful; and (in my own observations) I have thought I found all the colours of Mite-gall which are mentioned separately by different writers; sometimes bright rose-colour, sometimes green, as well as brown in the advanced stage. The following notes on the *Phytoptus similis* are abridged from the full description, by Dr. Nalepa, on page 89:—

PLUM-LEAF FUNNEL-SHAPED GALLS.—*Phytoptus similis*, Nalepa. "Body cylindrical; female five times as long as broad. Thoracic shield three-cornered, with somewhat angularly curved out margin." . . . "The proboscis is short (0·015 mm.), strong, and directed downwards and forwards. The legs are strong and distinctly jointed; the last joint is inconsiderable, shorter than the preceding. The bristles are very fine and moderately long. The claw is short; the holding-claw ('Haftklaue') is very slender, feather-like and five-branched. The abdomen is uniformly ringed (about 60 rings), and rather coarsely punctate. The egg round, 0·036 mm."

P. similis produces the galls on the leaves of *Prunus domestica*, L., shown at Plate VI., fig. 6. They are known under the names of *Cephaloneon hypocrateriforme* and *confluens*, Bremi, and are pouch- or funnel-shaped. They are mostly found on the edge of the leaves, but rarely on the leaf-stalk, or at all on the twigs or fruit? They are always few, with stiff hairs, and form one with another a surrounding boundary fence, commonly to the upper side of the leaf, less frequently to the under side. ? *Volvulifex Pruni*, Am.*

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* 'Praktische Insecten Kunde,' by Dr. E. L. Taschenberg, Part V., pp. 159, 160.

On the 7th of June, some Damson leaves, infested to an unusual amount round the edges by the above-named little lumpy galls, were sent me by Mr. C. D. Wise from Toddington. They also infest the leaves of the Sloe (*Prunus spinosa*, L.), but I have never found them myself in large numbers, nor had them reported as the cause of serious mischief.†

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* (*Loc. cit.*, p. 87) pp. [53, 54] 14, 15, Plate VI., Figs. 2, 3. Also see reference in 'Katalog' there cited, p. 299.

† The following technical description of *P. similis* is given as a single example of the clear and thorough method of description of very many *Phytoptal* infestations in the successive publications of Dr. Nalepa.—E. A. O.

Phytoptus similis, Nalepa.—"Korper walzenformig, ♀ funfmal so lang als breit. Thoracal-schild dreieckig, nach hinten scharf abgesetzt, mit etwas winkelig ausgebogenen Seiternrändern. Die Zeichnung des Schildes ist sehr deutlich und besteht aus einer Anzahl unregelmässig wellig verlaufender Linien, zwischen welchen in den Seitentheilen noch strichformige Hocker sichtbar sind. Die Hocker der Rückenborsten stehen vom Hinterrande ziemlich entfernt und tragen die steifen, kurzen, nach aufärts gerichteten Rückenborsten.

"Der Rüssel ist kurz (0·015 mm.), kräftig und nach abwärts und vorne gerichtet.

"Die Beine sind stark und deutlich gegliedert, das Endglied ist unbedeutend kürzer als das vorhergehende. Die Borsten sind sehr fein und ziemlich lang. Die kralle ist stumpf, die Haftklaue sehr zart, federförmig, funfstrahlig. Sternalleiste ziemlich lang, Epimeren ziemlich kurz. Zweites Brustborstenpaar über den Epimerenwinkel und der Sternalleiste sehr genähert.

"Das Abdomen ist gleichmässig geringelt (circa 60 ringe) und ziemlich grob puncktirt. Der Schwanzlappen ist deutlich und schmal, die Analborsten sehr lang und wie die Abdominalborsten ungemein zart. Nebenborsten fehlen. Erstes Bauchborstenpaar sehr lang und fein, zweites Paar sehr kurz, kaum sichtbar.

"Die aussere weibliche Geschlectsapparat sitzt unmittelbar unter den Epimeren. Die untere Klappe ist halbkugelig, beckenformig, die obere gewölbt und glatt. Genitalborsten noch seitenständig.

"Eier rund, 0·036 mm.

"Lange des Weibchens circa 0·23 mm., Breite circa 0·045 mm., Breite der ♀ Geschlechtsöffnung 0·026 mm.

"Lange des Männchens circa 0·15 mm., Breite 0·04 mm. *Phytoptus similis* hat eine auffallende Ähnlichkeit mit *Ph. goniothora* aus den Blattrandrollungen von *Cratægus oxyacantha*, L., doch interscheidet er sich leicht von diesem durch die bedentendere Grösse, die Zeichnung des Schildes, die Haftklauen und das schmaler geringelte Abdomen.

"*Ph. similis* erzeugt die Taf. VI., Fig. 6, abgebildeten Gallen auf den Blättern von *Prunus domestica*, L. Sie sind unter dem Namen *Cephaloneon hypocrateriforme* und *confluens* Bremi bekannt und sind taschen-oder trichterformig. Man trifft sie meist am Rande des Blattes, nur selten am Blattstiel oder gar an den Zweigen oder Fruchten (?). Sie sind immer sparsam, steif behaart und besitzen einen von einem ringformigen Wall umgebenen Ausgang in der Regel an der Blattoberfläche, seltener auf der Unterseite. ? *Volvulifex Pruni*, Am."

'Zur Systematik der Gall-Milben, in Sitzungsber d Kais Akad. d. Wiss. in Wein,' 1890. Separate impression, pp. 14, 15 [53, 54].

Black Currant-bud Gall, *Phytoptus ribis*, Westwood and Nalepa.—This is the species which is the most hurtful to us of any of the *Phytopti*, and we know it generally as a cylindrical Gall Mite, with the abdomen uniformly ringed, with four legs, and multiplying by eggs, and otherwise coming under the description of the genus *Phytoptus*, of the sub-family *Phytoptina*, one of the two great divisions of the family of the Phytoptidæ.

The description of this Gall Mite, and the plate in which it is figured, are in course of preparation by Dr. Nalepa.

The galls we know only too well, as buds swelled into round or irregularly shaped growths, sometimes hardly advancing beyond mere small balls of deformed embryo growth, sometimes advancing so far as a slight development of the leaves, or possibly of the flower-buds. Accompanying this gall formation, both within its scales, and more generally dispersed, there are very commonly to be found minute gold coloured round bodies or drops, which would not be worth alluding to excepting for these having been recently brought forward and figured (in this country) as a form of gall caused by the same Gall Mite that forms the distorted bud gall. *This I believe to be wholly inaccurate.* From the time of my first observation of this Black Currant attack, I have noticed these yellow globules, and never found them to be other than little globules of moisture, neither have I been able on enquiry to find that they had been, on the investigation of other observers, to be anything but little round gold coloured fluid drops.

One of the earliest of the communications sent me last season was forwarded, with specimens accompanying, on the 7th of April, from Bekesbourne, near Canterbury, by Mr. W. Gardner. In this instance, the fourteen twigs, or lengths of twigs, of Black Currant were severely beset with the roundish swollen gall growths, caused by the *Phytoptus ribis*. On one of the shoots which was slightly branched into six short side-twigs, I counted as many as twenty galls in a length altogether of less than twenty inches. The galls were of different sizes, but in a large proportion they were of three-fifths, or more than three-fifths, of an inch in diameter. The *Phytopti*, or Gall Mites, within were of various stages of growth.

This attack proved very destructive to the hopes of a fruit crop. On the 2nd of October, Mr. Gardner again sent me specimens (in this instance a large packet), showing what might be certainly described as an overwhelming amount of infested and malformed buds, and the shoots on which these were placed were themselves so stunted and distorted in growth by effects of previous infestation, as to some degree to resemble the condition of Birch twigs, before the *Phytoptus* growth, known as "Birch-knots," has developed beyond its first stages.

Mr. Gardner remarked:—"I think I told you that I only gathered half a bushel off nearly five acres. You will see the dead branches that should have borne fruit dried up. When I first discovered it (or soon after), I heard that people were washing; . . . but I could not see, nor can I now see, how washing them could do any good, they seem so completely in the bud, indeed many of the bushes look like dying. I saw a neighbour some time since who said they had had them more or less for five or six years, particularly on the 'Baldwins.'"

The following notes refer to the effect of cutting-back infested bushes as a means of checking the attack, and also to removal of the infested buds and destroying them as a measure of preventing increase, if not of getting rid of the infestation.

On the 29th of September, Mr. John Speir, of Newton Farm, Newton, near Glasgow, was good enough to favour me with the following observations:—"In further reference to yours of 26th ult., *re* Black Currant Mite (*Phytoptus ribis*), I have pleasure in saying that from an examination of the bushes to-day, I am inclined to believe that the treatment adopted has been entirely successful. I had only two affected bushes to experiment on, and of course owing to the small number experimented with, it would be rash to be over confident until other more extended trials are made.

"The details are as follows:—The two bushes (about ten years old), and both with single stems, were affected all over, and during the autumn of 1891 they were cut down to within two or three inches of the ground, the branches being carefully gathered together and burned. A mixture of soft-soap, half a pound, dissolved in one gallon of hot water, to which two gallons of paraffin oil had been added, and well stirred, and afterwards mixed with an equal quantity of cold water, was syringed on to the stumps of the old bushes, the bushes round the affected ones, and all the ground round about.

"One of the bushes came away healthy and strong the following spring, but the other looked very delicate for a considerable time; ultimately, however, it seemed as healthy as the other. During the spring of 1893, no affected buds were noticed, neither on the bushes which were cut back, nor on the others surrounding them, and this year, although very much deprived of light and air by the higher bushes around them, both seem in a very favourable way of making good growth and healthy wood in the future.

"I am inclined to believe that these bushes were cut back a little too far, but I had had so many failures in attempting to eradicate this pest in the past, that I wanted to be as sure this time as possible, well knowing that if the treatment was successful other attempts could be made later on with longer stems. If the stems were a few inches longer, more stronger growth would come away, and the plant would sooner be a bush again. As my stock of affected plants is now all used up, I cannot make another experiment until I get hold of one or more diseased plants, but I think the treatment might be equally successful by cutting off the branches, say, six inches above the ground.

"Two parts of paraffin easily combine with one part of water when soft-soap has been dissolved in it, the combination forming a white thick fluid like butter-milk. This forms the stock, and may be diluted to any extent, according to the purpose for which it is used. These few particulars I hope will serve your purpose."

On the 5th of October, Mr. Speir wrote me further regarding the benefit, but still only partial benefit, which he had found to result from removing the infested buds:—"Prior to 1890, I had several bushes affected with the Gall Mite, and could experiment freely with them without running the risk of killing off my stock of diseased bushes, and for several years previous to that, I went over each of several bushes once every week with the most extreme care, and plucked out every affected bud as it showed itself during the spring and early summer months. These buds I carefully kept, and at once carried them to the fire, where they were destroyed. In this way I succeeded in preventing the disease from increasing, or from very much disfiguring the bushes, but on no plant did I succeed in eradicating the mischief. The most I succeeded in doing, was to prevent the disease from becoming worse, and that was at an expenditure of time and patience altogether out of proportion to the value of the crop. It therefore seems probable to me that in spring you will find your efforts in a similar direction have not met with a due reward. It will, however, be interesting to note how your experience compares with mine."—(J. S.)

In the course of the summer I had had the advantage of examination of my Black Currant bushes together with Mr. Speir, and though nothing I can do in any way can rank with the vast scale of observation carried on either at Toddington or Newton, it seems to me that for moderate garden growing, where a great extent of land has *not* to be dealt with, that disbudding and destroying the buds is one of the best *preventives* that we know of as yet. For on a moderate or small scale every bush may be thoroughly gone over, and every bud removed without great cost, and we get rid of much infestation which would have presently spread.

In reply to some remarks on this treatment which I wrote to Mr. C. D. Wise, Superintendent of the Toddington Fruit Ground, Winchcomb, Gloucestershire, he remarked:—"I am inclined to think that this is a more sure remedy than spraying with any mixture; at all events we have found the pests greatly decreased by adopting this remedy."—(C. D. W.)

The treatment of destroying the galled buds taken in connection with syringing of Paris-green on the bushes, and dressing with caustic lime below them, has been found so serviceable on two years' experience of its effects by Mr. John Biggs, of Laxton, Howden, East Yorkshire, that I repeat his note of experiment of 1892, together with his observation contributed this year (1893) of the continued success.

Mr. Biggs observed, writing on the 20th of April (1892):—"You will, I am sure, be interested in knowing that I have, to a certain extent, prevented the *Phytoptus* utterly ruining my Black Currant trees. As you suggested in a letter of last March, we syringed the bushes twice with the solution of Paris-green, which I procured from Messrs. Blundell,* and gave the soil all under the bushes a good coating of caustic lime. I also gave the bushes another dressing of the Paris-green. Just when the buds appeared this spring I had a boy gathering all the little knobs off the trees. The result has proved as satisfactory as I could expect, considering the condition of the trees last year, and I have every prospect of securing a good half crop. Our neighbour's trees, in this village, are utterly ruined, scarcely a leaf to be seen this year, and the trees completely covered with the affected knobs."—(J. B.)

On the 7th of March of the past season (1893), Mr. Biggs wrote as follows:—"I may say with reference to the *Phytoptus*, that I have very few infested Currant trees this spring, and I am confident the treatment of Paris-green and caustic lime is a valuable remedy. As soon as the buds open out slightly, I intend syringing the trees, and hope to completely eradicate the pest without injuring the trees otherwise than by cutting off some of the worst infected branches."—(J. B.)

This treatment, it will be seen, comprehends method of cure, or prevention for the Mite presence, in all the three localities in which we have to do with them. There is the mechanical measure of breaking off the infested buds and destroying them, by which we get rid quite safely and surely of all the Mites and eggs on which we can lay our hand. Then secondly, the syringing with Paris-green poisons the surfaces of the stems, or other parts of the bush on which the Mites are wandering free, so that those which are straying about are killed; and thirdly, the good dressing under the bushes with caustic lime gets rid of such of the pests as are harbouring about fallen leaves, or in any shelter on the surface of the ground. On the face of the thing the plan seems to meet the various needs of the case. The applications might be varied experimentally, where there was objection to use of Paris-green, by trying good washings with soft-soap and paraffin, or soft-soap and sulphur, or a mixture of some gas-lime with the caustic lime.

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* Address of the firm is, Messrs. Blundell & Spence, Hull.

In the earlier part of this paper, I have particularly drawn attention to the subject of the facilities now given for scientific identification of the Gall Mites, or Phytoptidæ, as I believe that this meets a great need for all who have to teach or who are consulted on the nature of these "Mites," or the injuries they cause. For common use in garden or field work, the nature of the diseased growth must necessarily be the distinguishing mark of the kind of attack; but we have greatly needed some work of reference from which those who wished to know all concerning these Mites (as classification of sub-families and distinctions of genera, and also complete details regarding distinctions of species so far as at present published, in addition to life-history of the family) could tell, or be told, all that can be needed.

There are many works embodying much useful information on the Mites, and on the results and means of prevention of some of the infestations, and amongst those easily accessible to all here, and very serviceable, both in its short descriptions of gall, or diseased growth, caused by Phytoptidæ, and also in its masterly sketch of the rise and progress of Phytoptal discovery and observation up to date of publication, about seventeen years ago, is the paper compiled by Andrew Murray, F.L.S., given at pp. 331—374 of the octavo volume entitled 'Aptera' (Chapman & Hall, Piccadilly, London). In this, at p. 346, will be found a magnified figure of a *Phytoptus*, and still more greatly magnified figure of the anterior extremity, with its two pairs of legs, and "feather-bristle" claw. These, after figures by Dr. Franz Löw, the well-known observer of many Mite-galls and their Mite originators. These so far as they go would be a great assistance to many who have not the opportunity of studying the elaborate publications of technical observers; and so far as representation of the legs as definitely jointed into *coxa*, *femur*, *tibia*, and two-jointed *tarsus*, bearing a feathered claw, are valuable aids to students. With regard to the side claw, it appears to me very likely that that would now be differently represented with the improved microscopic powers of the present day, but the feather-claw is an important point.

Those who wish to study the most recent publications on Phytoptal observation in Austria, Italy, or France, will find a list of these in the 'Katalog der bisher beschrieben Gall-Milben ihrer Gallen und Nahrpflanzen, nebst angabe der einschlägigen Literatur und kritischen Zusatzen. Zusammengestalt von Prof. Dr. Alfred Nalepa, in Linz-u-Donau. Abdruck aus der Zoologischen Jahrbuchern (Gustav Fischer, in Jena).

The publications by Dr. Nalepa, from which I have quoted in the preceding paper, are the 'Beitrage z. Syst. d. Phyt., Sitzsb.,' 1889, 98. = 'Beitrage zur Systematik der Phytopten, in: Sitzungsber. d. Kais Akad. d. Wiss. in Wien,' 1889. Bd. 98, 1, 1889; also, 'Zur Syst. d.

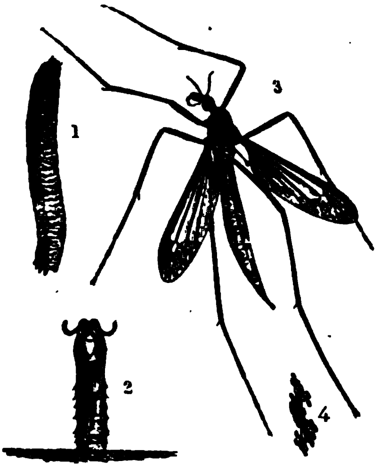
Phyt., Sitzgsb.,' 1890, 99. = 'Zur Systematik der Phytopten, in: Sitzungsber. d. Kais Akad. d. Wiss. in Wien,' 1890. Bd. 99, 1.

The first mentioned in the two above paragraphs are separate impressions from the Reports of the Imperial Nat. Hist. Society of Vienna, to which the reference follows each title, and I give both references, as the cost of the pamphlets, 8/6, or thereabouts, is very considerably less than that of the volumes of the Reports or Transactions of the Imperial Society.

For those who might perhaps be in doubt as to how to procure them, I may mention that Messrs. W. Wesley & Son, Essex Street, Strand, London, W.C., have made arrangements to procure them on application.

STRAWBERRY.

Daddy Longlegs; Crane Fly. *Tipula oleracea*, Linn.; and other species.



TIPULA OLERACEA.—Daddy Longlegs: 1, larva; 2, pupa-case standing up in the ground; 3, fly; 4, eggs.

Amongst the communications sent in during the past season regarding the very well-known field pests, the grubs of the Daddy Longlegs, there were two which may perhaps be worth noting, as referring respectively to presence of the grubs in a garden crop not often reported as infested by them; and in the other to effect of rape-cake (? mixed with Mustard) in poisoning the grubs, which point may be worth further experimental enquiry.

About the Strawberry bed infestation. On the 1st of June, an enquiry was sent me from Newmains, Scone, Perth, N.B., by Mr. J. G. Bryden, accompanied by specimens of Daddy Longlegs grubs, nearly or quite full-grown, and as nice healthy specimens as one could have wished to see if beneficial insects.

Mr. Bryden noted:—"I enclose specimens of grub, or caterpillar, found among my recently planted Strawberry runners. They are found about the roots of the plants, and seem to commence their work of destruction by severing the leaf-stems from the roots immediately below the ground, thus killing off large numbers of otherwise healthy plants.

"The land is of very moderate quality, and variable, from stiff loam to fine free soil; the grub, or caterpillar, is over all alike; it was manured with ordinary farmyard manure, with four cwt. bone meal additional.

"What treatment do you think would be successful in eradicating the pest, and save my plants? I will be planting again next spring, and should much like to know if by any application I could save my Strawberries from such an attack in future."—(J. G. B.)

It will be noted in the above communication that the Strawberry ground was manured (besides the bone meal) "with ordinary farmyard manure." It is very likely that the grubs might be conveyed in this to the Strawberry beds. This kind of grub is to be found at times in farm manure; and in 1883, one of the years in which damage by these *Tipula* larvæ was being especially reported, I had a good note from Mr. David Byrd, Tarporley, Cheshire, a very careful observer, mentioning, with regard to some Turnips, that "the Daddy Longlegs grub was there in numbers, carried into the field with the foldyard manure, and spread in the ridges."

In the previous year (1882), I received information from Felhampton Court, Church-Stretton, of "great injury being caused to a bed of Strawberries by means of a grub," which turned out to be of one of the smaller kinds of *Tipula*, apparently the *T. maculosa*, or "Spotted Crane Fly," which appears to be just as injurious as the *T. oleracea*, more especially observed as the Daddy Longlegs. In this instance "the plants had been top-dressed in the autumn with nearly rotten horse manure, and at the time of writing were coming through nicely, but about twenty per cent. failed, going off after they first started. The grub was to be found with its head well into the heart of the young plant, and the leaves all bitten through at the bud." *

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* 'Report of Observations of Injurious Insects for 1882,' by E. A. Ormerod, p. 16.

To get rid of the attack, scooping away the earth round each plant was tried, and proved perfectly successful. About half the plants were found to be infested, often with four or five grubs round one plant, but some (nearly or quite destroyed) with only one. The single clearance was quite effectual, not another plant being lost afterwards.

Where the Strawberry grounds are on too large a scale for the above treatment to be considered applicable, it would be well worth while to try the effect of trapping. The grubs will sometimes collect in great numbers under sods. In 1888, in some information placed in my hands by the Hon. Cecil Parker, writing from the Eaton Estate Office, Eccleston, Ches., he mentioned: "*Dozens of grubs are found under a sod*"; and later on, from another correspondent, I had a note of no less than ninety-four grubs having been counted beneath a single sod "which had been brought to the surface by the harrow, and then pressed down by the roller, so as still to retain a little moisture." Following up these observations, I have suggested placing damp turfs at infested spots, and clearing them from time to time, and the plan has been found to some extent successful.

In a limited space such as Strawberry beds in garden growing, the plan might very likely be serviceable; or clods, bits of slate, or flat stones, which would afford a cool, damp, and dark shelter for the grubs, would very likely also answer, at least they would be worth trying, as with this crop, at the time of year when the grubs are most mischievous, it is nearly impossible, or quite impossible in some cases, to bring the regular remedies to bear which are commonly tried in field service.

A further point, however, might be tried as to effect of rape-cake for drawing away the grubs. They have been known to remain in it long enough in field treatment for the roller to be taken over them, and thus many may be killed, and in garden culture the beds might be hand-picked; but, beyond this, a note I received last season points to possibility of killing them by the application of rape-cake.

On the 5th of August, Mr. R. Scot Skirving, writing from Foreland House, Island of Islay, N.B., regarding methods of destroying the grubs of the *Tipula oleracea*, of which he observed: "I have had only too much experience," remarked that the measures I suggested were good, but that he had found that *crushed rape-cake* sown over the surface of the field answered much better. "The grubs were seen in hundreds dead on the surface." . . . "I then followed it up by lightly dressing the field with nitrate of soda to stimulate the growth of the plants."—(R. S. S.)

On making further enquiry of Mr. Scot Skirving, he told me that he could not now give me precise details as to the kind of rape-cake used, but that at the time he wrote of, the use of the cake was general in East Lothian. It was the *common* rape-cake that was used for the cattle.

"It *tasted* of Mustard seed. Cattle did not like it at first, and had to be coaxed by mixing it with linseed-cake. It was used because it was *cheap.*"

On turning to Youatt's 'Complete Grazier' (18th Edition, 1893, rewritten and enlarged by Dr. Fream), at p. 206, I find the following statement, which confirms Mr. Scot Skirving's views as to the nature of the rape-cake, and may bear serviceably on the subject of its possible effects:—"*Rape-cake* is less relished by cattle than linseed-cake, and they require to be coaxed into partaking of it; once habituated to it, they consume it freely. Dr. Voelcker says he believes 'the pungent principle in rape-cake arises from the presence of Mustard seed, which is often contained in considerable quantities in foreign rape-cake.' Mustard and Rape seed belong to the same family of plants; and in Germany at least, I am sorry to say, our Rape fields are often very foul with Mustard."

The above quotation explains the taste of Mustard being present in the cheap cake alluded to by Mr. Scot Skirving, and if in the coming season any correspondent should be disposed to kindly let me have a supply of a few dozen Daddy Longlegs grubs,* I should be glad of the opportunity of making some experiments, such as I tried in 1882,† with regard to effect of rape-cake, and also of Indian, or Kurrachee rape-cake, that is, cake formed of Mustard seed, on Wireworms.

These were undertaken to ascertain whether there was any foundation for the popular idea that Wireworms feed on rape-cake to such a state of repletion that they burst. Such, however, did not prove to be the case. The Wireworms that were fed solely on true rape-cake for several weeks (broken up and moistened) went into it at once, and continued to thrive until there appeared no reason to continue observation any longer.

Those fed on the Kurrachee, or Mustard-cake, on the contrary, refused to enter the cake for about three days, and remained in a bit of turf which I had placed as a temporary and optional shelter for them. About the fourth day, when a putrescent smell had succeeded the first stinging scent of the moistened Mustard-cake, the Wireworm went into it, and did apparently well for more than a week; but at the end of a fortnight I found many dead or dying, and though I supplied them with fresh turf, also pieces of Potato and Turnip, as well as the cake, they all died.

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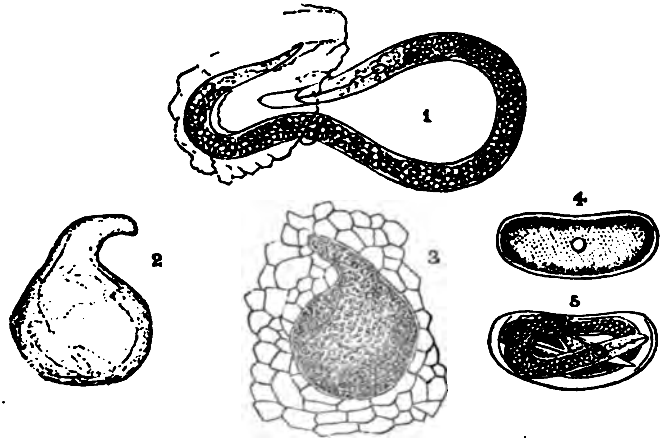
* If a letter or card was sent beforehand, this would enable me to have all ready.

† See 'Report on Injurious Insects for 1882,' p. 47.

Looking at the apparently much greater susceptibility of Daddy Longlegs grubs, that is, of the larvæ of the *Tipula* flies, than those of the larvæ of the *Elater* beetles, commonly known as Wireworms, to the action of food, it would be well worth while to experiment a little on the above subject, as in case such broadscale application of Mustard-cake as is practicable in field service turned out customarily to be prejudicial to the *Tipula* grubs, it would be an exceedingly convenient addition to our knowledge.

TOMATO.

Also Cucumber Plants, &c., infested by the **Root-knot Eelworm.** *Anguillula radicicola; Heterodera radicicola*, Greef.; *Heterodera radicicola*, Müller.



Heterodera radicicola.—1, larva; 2 and 3, females; 4 and 5, eggs in different stages of development: all enormously magnified. (2 from sketch by Ed.; the other figures after Prof. Geo. Atkinson).

In my Report for 1892, at pages 127—137, notes are given of the observation of what I believe to be the first definitely recorded, and specifically identified, appearance in this country of the destructive Eelworm infestation, known by reason of the galls, or knots, to which it gives rise on the roots of many different kinds of plants, as the Root-knot Eelworm, and scientifically as the *Heterodera radicicola*.

Full details (or at least sufficiently full details for identification of the attack) were then given, partly from the English specimens placed in my hands, but also from the scientific details and correspondence on the subject, with which I was favoured by Dr. J. Ritzema Bos, Professor at the Royal Agricultural College, Wageningen, Netherlands, and also from the published information given by Dr. Neal, now Director of the Agricultural Experiment Station, Oklahoma, Ind. Territory, U.S.A., and more especially (duly acknowledged, as in the other cases) from the minute and carefully recorded observations of Prof. Geo. F. Atkinson, Professor of Biology at the Agricultural Experiment Station, Auburn, Alabama, U.S.A.*; but a few lines of the latter are repeated now to save trouble in reference, regarding some of the main characteristics, and especially those by which this "Root-knot" Eelworm is clearly distinguishable from the "Stem Eelworm," the *Tylenchus devastatrix*, known as causing Tulip-root, or Segging, in Oat plants, and Stem-sickness in Clover.

The eggs of the Root-knot Eelworm (see magnified figures, p. 99) are stated to be, when mature, about three- to four-thousandth of an inch in length, and the young wormlet, or larva, when it comes out of the egg, to be from twelve- to sixteen-thousandth part of an inch in length, and, like the adult male, it is thread-like in shape, and also, like it, has at the anterior extremity, in the opening of the gullet, a fine point on a trilobed base, known as the "exsertile spear."

The life-history is, that the young wormlets wander about for a time, then presently come to rest in the plant tissues, and undergo a change. The body of the larva, or wormlet, is stated to enlarge, excepting at the two ends, and forms a kind of "cyst," or chamber, in which the change of the Eelworm to the adult state takes place. If this is to the male condition, the wormlet in its chamber is stated to lengthen and become more slender and thread-like, until it is curled round several times within the chamber formed of its old larval skin; and when the change is complete, it breaks forth, roams in search of its very differently shaped mate, pairs, and dies. Its measure when full-grown is stated to be about one millimetre (the twenty-fifth of an inch) in length, and only the seventeen-thousandth of an inch at the middle, tapering to about half this width at the extremity at the head end, in which the œsophagus, or gullet, is placed, which is furnished at the foremost end with a minute needle-like point, which can be thrust out and retracted, and rests on a trilobed base. It will thus be observed that these *male* Root-knot Eelworms, from the time they quit the egg up to the perfectly developed condition, preserve the same thread-like, or fine eel-like, shape.

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* 'A Preliminary Report upon the Life-history and Metamorphoses of a Root-gall Nematode, *Heterodera radicicola* (Greef.), Mull., and the Injuries caused by it upon the roots of various plants,' by Geo. F. Atkinson. Science Contributions from the Agricultural Experiment Station, Alabama, U.S.A., Dec., 1889.

With the females, however, this is quite different (still continuing to abridge from Prof. Atkinson's observations, it is noted); "the female does not moult again, but continues to enlarge enormously until it is gourd-shaped," see figures of this gourd- or pear-shape, p. 99; this female gradually becomes filled with eggs and young larvæ; and the length of the life cycle is given by Prof. Atkinson as one month.

In the very large amount of specimens of galled Tomato roots sent me in the winter of 1892–93, I had good opportunity of observing these peculiarly shaped Eelworms, and their contents, so far as could be done with moderate microscopic powers, and their description, and that of the galls on the roots, is given in my Report; and later on, towards the end of March, I was able also to examine the nature of the root-knot galls, and the condition of the Eelworm tenants in galled Cucumber roots, sent me by Mr. Hamilton H. Hurnard, from Gurney's Manor, Hingham, Attleborough, Norfolk.

Mr. Hurnard first wrote as follows:—"Last year I was very much perplexed at the condition of my Cucumber roots; no plant died, but they were not a success. This year I have lost plant after plant." On March 23rd, Mr. Hurnard forwarded me, for examination, two roots of Cucumbers taken from a large pot at seven o'clock that same morning, with the very just remark: "It is really heartrending to go into my Cucumber house and see a plant or two dead every morning, with Cucumbers of all ages on it."

On examining the specimens sent, I found the galls on the roots were very similar, both in position and appearance, to those described, on Tomato roots, in my 16th Report, p. 131, and figured on the accompanying plate about two-thirds natural size; but the Eelworms within them appeared to be not so far advanced as those in my winter specimens.

In these Cucumber galls there were many of the thread-like forms of this Root-knot Eelworm, of different sizes, some exceedingly minute; but I did not observe more than one instance of what might be a developed female. In this case the pear- or gourd-shape was observable, but the wormlet was rounded out at the base, that is, more of a tulip-bulb shape, without the central depression being noticeable. There were also one or two going through pupal changes.

With regard to specimens of this Cucumber root infestation, which I submitted to Dr. J. Ritzema Bos, Wageningen, Netherlands, for his skilled examination, he was good enough to report to me on March 27th as follows:—"In the galls I find different Nematoid worms; *Heterodera radicicola*, in different stadia of development, and some other Nematodes, which live in the decayed matter of the galls (*Diplogaster* and *Rhabditis* species). Of the *Heterodera radicicola*, I found one completely developed female, some males, and different stadia of the larvæ, like those in Plate IV., Figs. 9, 17, 18, 21, of Atkinson's 'Report,' and ova."—(J. R. B.)

The Cucumber infestation which we have here, was thus found to correspond both in the kind of Eelworms, and in the galls to which they gave rise, to that of the *H. radicicola*, and its effects, already studied on Tomato roots; and it was of some interest to contrast the condition of the Eelworms, in the one case (in the spring) being to a great extent growing up to maturity; and in the other, in the old matured galls towards the close of the year being so much more observably represented by adult specimens, especially the gourd-shaped females with their larval or egg contents.

The galls on the various kinds of plant roots on which I have seen them, that is, on roots of Tomato, Cucumber, and on roots of one young Lettuce plant sent me for examination from Belgium, were small knobs, or irregularly shaped lumps, varying in size from an eighth of an inch or less in diameter to (in the case of the Tomato) fleshy lumps a quarter of an inch to half an inch or more in width, and much more in length; even to as much as one, two, or over three inches of irregular swollen gall growth along the root fibres where the galls were confluent.

The method of infestation may be in various ways. The Eelworms may escape into the earth through cracks in the gall, or may make their way out by use of their mouth-spear; or again, as I found in the case of the Tomato galls sent me late in the year, may be freed in myriads by the peeling off of the outer part of the coat of the "root-knot." But in whatever way the Nematode may have conveyed itself into the ground, the next step, that of its entrance into the plant to be attacked, is thus described by Prof. Atkinson,—p. 16 of pamphlet cited.* "Having escaped from its confinement," . . . "it immediately selects another part of the root, or a fresh young rootlet, for attack, and places itself in position for the siege. Bringing into play its exsertile ram, it forcibly gains entrance to the healthy tissues of the root," &c. There the parasitic action sets up the diseased swelled growths, which, as we now know in England to our sorrow and loss, carry off the plant juices to supply the growth of these vegetable tumours, and ruin the hopes of the expected crop.

A further word should be added as to the need of great care in all investigations as to the nature of the tenants of the root-knots; those who are not well accustomed to the identification of Nematodes, cannot be too strongly warned against the error of mistaking these *Heterodera radicicola*, or Root-knot Eelworms, for the *Tylenchus devastatrix*, or Stem Eelworm. The exceedingly minute resemblance of the first-mentioned in larval and male condition to the second in every state, that is, larval, male, or female, has led to repeated and grave error; and the gourd- or pear-shaped females should always be searched for carefully, though, even in the absence of these, it is entirely presumable that the formers of the "root-knot" galls will be the *H. radicicola.*

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* See footnote, p. 100.

PREVENTION AND REMEDIES.—These at present appear, as a certainty, and at a paying (or indeed practicable) rate of outlay, to have eluded the most careful research. Some good it is considered may be done in special growing (as where one kind of crop can be kept thoroughly in hand, in limited space, or under glass, or in pots), by use of what are called trap-plants. That is, by sowing some small crop which is an object of attraction to the Eelworms, such especially as Lettuce, sometimes known as Salad, and keeping watch on these until it is found that galls are forming on the roots, then removing them, and destroying them with the contained pests. But in this treatment the utmost care must be taken in removal of the "trap-plants," for if they are drawn from the soil, however carefully, some of the galls, and with them the Eelworm tenants, will be likely to remain behind.

Such matters of precaution as carefully destroying all infested roots, and on no account letting them be thrown to rubbish heaps; also avoiding use of soil in which infested plants have grown; and also taking care that such infested soil is not carried about on garden tools, or on boots of garden labourers, or wheels of barrows, are all measures of at least lessening spread of the infestation. Also it has been found that the "root-knot" is worse in long cultivated and fully fertilized and thoroughly pulverized areas, than in compact and virgin soils. Such of these points, however, as seemed serviceable for general use, have been alluded to, with authorities given, in my preceding Report, and those who wish to study the subject in minute detail will find excellent information, both with regard to the Eelworms, their habits, and such means of counteracting their ravages as are known, in the works mentioned below.*

The following observations refer entirely to a long and careful series of experiments tried by the observer, from whom I received the infested Tomato roots mentioned in my Sixteenth Report. From the losses sustained by him, both in Tomato and Cucumber growing on the very large scale carried on in his houses, extending over many acres, he considered it would be worth while for him to try the effect of a large variety of chemical applications, carefully observing and noting effects of each, both on the Eelworms, and on the plants.

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* 'A Preliminary Report upon the Life-history and Metamorphoses of a Root-gall Nematode, *Heterodera radicicola, &c.*,' by Geo. F. Atkinson.—A Science Contribution from the Agricultural Experiment Station, Auburn, Alabama, U.S.A., December, 1889.

'The Root-knot Disease, &c.,' by J. C. Neal, Ph.D., M.D., U. S. Department of Agriculture. Washington: Government Printing Office, 1889.

The first series of observations was conducted on Tomato plants in pots. In every case pots were used that held four and a half pounds of soil when fairly dry, and soil that was known to be infested with the "Root-knot" Eelworms. About twenty-four different kinds of chemical applications were experimented with, the precise amount applied in each case being noted and stated in "grammes."* The observations were made in almost every case with different amounts of the chemical application, these amounts, together with the effect (or absence of effect) on the plants, and on the Eelworms, being carefully noted.

Thus in these first observations before me, we have a tabulated record, as correct as the most scrupulous care can make it, of about one hundred and twenty experiments; these in most cases giving the effects of at least two, and often three, amounts of chemical application, sometimes of many more, and thus forming an interesting record of their effects on plant life; also of the instances where neither plant nor Eelworm suffered; of some where the plant was injured, but the Eelworms were still to be found; and of some where the desired end was reached, of the plant continuing in good health, but no Eelworms being observable.

The result of this first series of experiments appears to show that there are a fair proportion of chemical applications which kill the Eelworm, but the expense of the applications would in almost every instance be far too great for remunerative broadscale use. The chemical applications made use of being with a few exceptions the same combinations which were used in the later series of experiments, of which the account is appended, it is unnecessary to give the list.

The detailed tabulated notes of the foregoing experiments were placed in my hands in June, but the observer being anxious to secure absolute certainty in his results, then (with the experience gained by these first experiments) commenced a second similar series, of which, with his permission, I subjoin his own condensed report.

I cannot help regretting that I am not permitted to publish the first set, as they give precise details, observed with scrupulous care, of effects on the plant and Eelworm life which are valuable in this rarely obtainable minute detail, and if given with the preliminary note that they were tentative preliminary experiments, would have freed the observer from the fear of either misleading, or of over-criticism of his long and careful work.

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* A "gramme" is, as nearly as possible, equivalent to fifteen and a half grains English.

Such, however, being the case, I now append only the later series of observation, which were sent me in October. These were made on both Tomatoes and Cucumbers, and the effect was much the same in each case. In the various returns, the most hopeful appears to be that of carbolic acid, but of this my observer remarks:—"As I expressed to you before, although carbolic acid will be effective in a field if properly mixed, I have very strong doubts about people succeeding in greenhouses, on account of the very many crevices in which the Eelworm will be able to harbour, and if I gave out this as a *cure*, people would be disappointed." *

The report of my observer's later series of experiments, sent to me during October, is as follows:—"I have now completed my experiments for killing the Eelworm, *Heterodera radicicola*, and, as promised, now send you an account of them. In my first experiment, I used pots that held four and a half pounds of infested soil, and to each pot I used the following chemicals, at the rate of one, two, three, and four grammes to each pot:—Magnesium sulphate, iron sulphate, tartaric acid, lead acetate, citric acid, sodium sulphite, sodium hyposulphite, sodium caustic, potassium sulphite, potassium permanganate, potassium chloride, potassium ferrocyanide, potassium sulphide, potassium sulphate, potassium caustic, potassium acetate, carbolic acid, and potassium cyanide. Gas-lime (fresh) up to twenty grammes; fresh caustic lime up to twenty grammes; tobacco powder up to eight grammes.

"The plants in the potassium ferrocyanide were all killed, even the plant to which I only used one gramme to the four and a half pounds. The plants in the gas-lime were sickly at twelve grammes; but the Eelworm was not even checked with twenty grammes. All the other plants did well, and were not injured in the least. The only things effectual in checking the Eelworm were carbolic acid and potassium cyanide when four grammes to the four and a half pounds of soil were used. In these pots only the smallest trace of Eelworm could be found, whereas the pots in which the other chemicals were used were a mass of knotted roots.

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* My observer requests me, for obvious reasons of business considerations and also inconvenience in time taken up in reply to applications regarding treatment, not to insert his name and address; but for scientific communication, he has allowed me to put him in communication with Dr. J. Ritzema Bos, Professor at the State Agricultural College, Wageningen, Netherlands, who aided us in identification of the Eelworms; and also with Prof. Atkinson, of the Agricultural Experiment Station, Auburn, Alabama, U.S.A.; and with Dr. J. C. Neal, Director of the Agricultural Experiment Station, Oklahoma, Ind. Territory, U.S.A., to whose published researches on the *Heterodera radicicola*, or Root-knot Eelworm, all who study the subject are infinitely indebted. I am therefore not without hope that the patience and care with which the observations have been conducted over months of experiments may produce more fruit than the observer is aware of, and (at least in scientific quarters) will be credited to the right owner.—ED.

"I then tried a second batch, using eight and twelve grammes to the pot, of all the chemicals I had tried previously, except gas-lime, caustic lime, and potassium ferrocyanide, which I abandoned; and carbolic acid and potassium cyanide, which I tried from six grammes upwards. I now found quite a number of the chemicals seemed to kill the Eelworm. Also that five per cent. of powdered charcoal seemed to kill it.

"My third batch of experiments were tried in beds of soil in which Cucumbers had been growing (and failed) through the roots being covered with the root-knots. The beds were divided into pieces containing fifteen cubic feet of soil, the weight of which would be about twelve cwt. Some of the chemicals previously used were now abandoned on account of their cost; and Paris-green and bichloride of mercury were tried for the first time. Up to one and a half cubic feet of powdered charcoal was used, and found of no use whatever; plants grew well. Up to eighty-two ounces of sulphate of iron did not affect worm or plants. Up to twenty-seven ounces of sulphate of copper did not affect either plant or worm. Up to sixty-six ounces of sulphate of potash did not affect either plant or worm. Two ounces of Paris-green made plants sickly, but five and a half ounces did not kill Eelworm. Three ounces of bichloride of mercury injured the plant, but six ounces did not kill Eelworm. Up to sixty-six ounces of sulphate of potash did not affect either plant or Eelworm; neither did sulphate of magnesia. Sixty-six ounces of sodium hyposulphite checked Eelworm only. But with thirty-three ounces of carbolic acid, hardly a trace of Eelworm could be found. The little that was found had probably come from the other soil after the effects of the carbolic acid had passed away. I cannot say that the plants were not affected by this quantity, but it was not much, and perhaps not at all. The plants might get a little check from other causes.

"You will now notice that my second and third batch of experiments do not agree with each other. Many things that appeared to kill in the second batch, quite failed in the third. I can only account for it in this way: the second batch were grown in pots on a stage in a greenhouse during June, July, and August. The sun was fearfully hot, and I had to complain to my man who had charge of the watering these plants for allowing them frequently to get very dry; and I think it probable that the continual watering and drying, with the hot sun shining on and almost baking the pots, acted injuriously on the Eelworm.

"Therefore the only thing I can recommend is carbolic acid. Potassium cyanide is much too costly; and sodium hyposulphite would be more costly if used strong enough to kill the Eelworm. And I am afraid carbolic acid, although the cheapest remedy I have found, will be far too expensive for the Americans to use. Thirty-three ounces to fifteen cubic feet is equal to 6000 lbs. to the acre, and would cost, for acid alone, about £75. Then, to be effectual, it should be thoroughly mixed with the soil with a fork: I am quite sure ploughing alone would not be sufficient. Then I think it should be used when the soil is moist, and not too cold; for the object should be to use the acid at the time when the Eelworm is most active. I do not think the strength I mention would kill eggs; and unless the eggs are quickly brought to life, the strength of the acid would pass away. I have seen Tomato plants nearly die when planted in soil directly after the acid was used and only moderately mixed, but after a week they began to recover, and soon made new roots, and grew as well as the other plants that were in soil where no acid at all was used.

"I am also very doubtful whether I shall succeed in getting rid of the Eelworm entirely myself. For, four years ago, my Cucumbers having what we called clubbed (and failed, and which I now know was caused by the Eelworm), we drenched the walls and surface of a house with carbolic acid. After, the soil the plants had been grown in was wheeled out. And we used the acid very much stronger than now seems to be necessary. And yet the Cucumbers clubbed and failed in the same way in the following year.

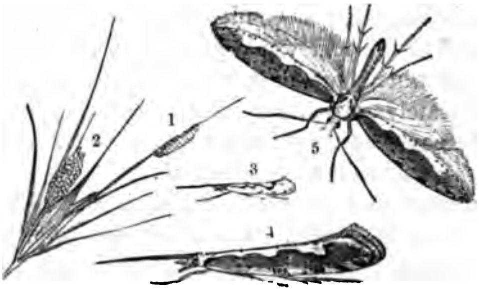
"In May of this year, I used carbolic acid in various strengths in a house where Cucumbers had grown. The greatest strength being nearly twice as much as the thirty-three ounces to fifteen cubic feet. But we did not plant Tomatoes in the soil until five weeks after using the acid. For a time it seemed as though most of the Eelworm was killed. But now, four months after planting, the Tomatoes are getting quite badly affected. It seems to me that in a greenhouse there are so many places in which they can harbour, that it is impossible to get at all. In a field it would be different; and I have not the slightest doubt but that a dressing of 6000 lbs. of carbolic acid to the acre, used properly, would completely clear the Eelworm.

"If you care to mention anything I have written in your Report, you are quite at liberty to do so, but, please, do not mention my name in it. If you are writing to Dr. Ritzema Bos, Dr. Neal, or Professor Atkinson, you may give them my name and address; and if they wish to write me for anything, I shall be quite willing to give them any further information I can.

"I may add, in using the carbolic acid, I always mixed it with about twenty times its bulk of water, and then used a water-pot, with a fine rose, to sprinkle the soil, thoroughly mixing the soil afterwards."

TURNIP.

Diamond-back Moth. *Plutella cruciferarum*, Zeller.



PLUTELLA CRUCIFERARUM.—1, caterpillar; 2, eggs; 3, Diamond-back Moth (all natural size); 4, 5, Diamond-back Moth, at rest and flying (magnified).

During the past season of 1893, so very little mention has been made of damage caused by the caterpillars of the Diamond-back Moth, that it seems worth while to notice this non-observation in sequence with the sudden and great amount of presence in 1891, and a good deal of injury in 1892.

It will be remembered that in 1891, a vast amount of mischief was caused by the small delicate green caterpillars of this moth (figured above at 1), to the leafage of Turnips, mainly along the coastland near the eastern seaboard of the island, and more or less in every one of the eastern counties, from Dover in Kent up to Aberdeenshire in Scotland. This was first reported about the beginning of July, and enormous flocks of the moths were also observed at various places along the eastern coasts.*

In 1892, the infestation was again present, but not to such a severe extent; also it was observed earlier in the season; the reports of damage ceased also earlier. The first notices of moth presence, respectively in Norfolk, Yorkshire, and in the county of Fife, N.B., and some other localities, were sent me in the latter part of May. Notes of caterpillar damage of these larvæ being spun up for the chrysalis state were sent on the 20th of June, and no reports of serious mischief were forwarded me after the 11th of July, and none at all after the 29th.

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* The fullest possible account of all details of this infestation, given from special reports of observations in the area of injury, will be found in my paper on "Diamond-back Moth," given in the Journal of the Royal Agricultural Society, Vol. II., Third Series, Part III., pp. 596—630; and at pp. 105—164 of my own 'Annual Report of Observations of Injurious Insects,' for 1891.

During the summer of 1893, I did not receive any observations of ravage, and scarcely any of the appearance of this attack; nor was there any report given by the agricultural press of continued visitation of the pests; and on communicating with Mr. E. A. Atmore, F.E.S., of King's Lynn, Norfolk, in which district the Diamond-backs had been very observable in 1891 and 1892, he wrote me as follows:—"*Plutella cruciferarum*, Z., the Diamond-back Moth, has been conspicuous by its absence (so to speak), for I have only seen two specimens, *imagines*" (*i. e.*, in moth condition—E. A. O.), "during the whole year, and no traces of the larvæ on Turnips, &c."—(E. A. A.)

It has seemed worth while to allude again to this infestation, which excited so much attention on its great outbreak in 1891, relatively to the possibility or great probability of it having been wind-borne from Norway, where, as we now know from the list of the 'Norwegian Lepidoptera,' * published by the State Entomologist, Dr. W. M. Schöyen during the past year, this species, the *P. cruciferarum*, is very widely distributed.

In this revised Catalogue, bringing the list of Norwegian Lepidoptera up to present date, Dr. Schöyen has tabulated the distribution of species in parallel columns, with the names of the provinces (or main districts, as Christiansand, Tromso, Finmark, &c.) in which their presence has been recorded, and the latitude of their most southerly and northerly observation.

From this it appears that the *Plutella cruciferarum*, known by us as the "Diamond-back Moth," has been recorded as present in all the eighteen main divisions of Norway, except Bratsberg and Bergenhus (N. and S.). Its distribution is from latitude 58° N. (that is, from the southernmost extremity of Norway), to 70° 42′ N., that is, further north than Hammerfest, and only a few miles short of the extreme north of the mainland of Norway, or, one might say, *to* the extreme north, as the few miles left are so indented with fiords, or arms of the sea, as really to leave very little land at all.

The above notes, taken from a work of authority and careful compilation, appear to me well worth observation in connection with insect appearances coincidently with easterly or north-easterly winds.

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* 'Fortegnelse over Norges Lepidoptera,' af W. M. Schöyen. (Christiania Videnskabs-Selskabs Forhandlinger for 1893, No. 13).

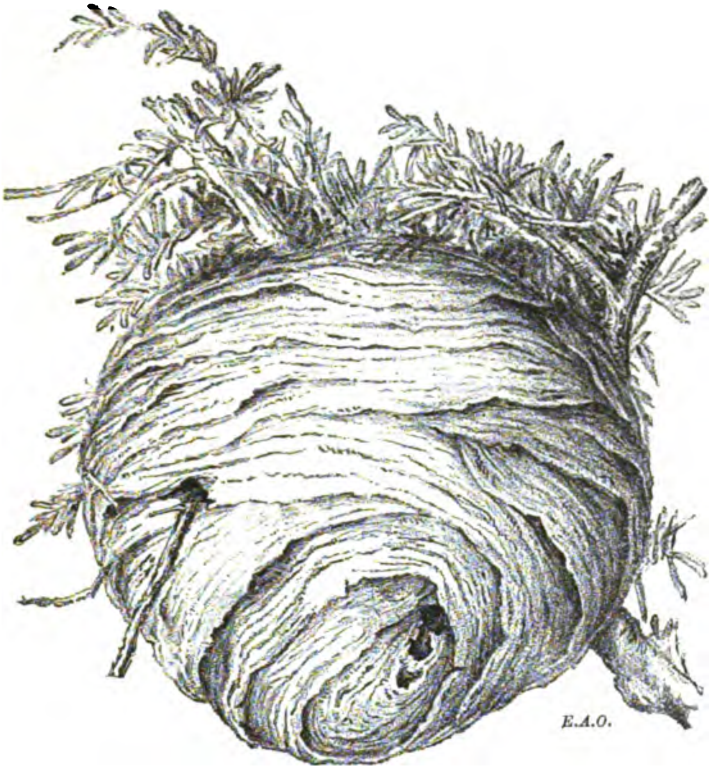
In the great appearances of Diamond-backs in 1891, we had record, in such data as were procurable, of the "cloud of moths" that arrived at the Farne Islands, being driven by the N. E. wind; and at Leith, in Scotland, the direction of the wind at 8 a.m. on the twenty of the thirty days of June (as given in the daily weather report issued by the Meteorological Office) was E., E.N.E., or N.E., points very notable in connection with the very great amount of attack which occurred in Fifeshire, a seaboard county especially exposed to the action of easterly and north-easterly winds.

At present, and in regard to this special infestation which gave so much sudden trouble in 1891, and, being established, set on foot mischief to trouble us, though ceasing earlier, and altogether not so severe in 1892; it is enough for us to be thankful that it did not recur over the infested districts (so far as appears) for a third time.

But for those who may need to trace the origin of future attacks, Dr. Schöyen's plainly arranged entomological and geographical columns may be of service; and it may be well to mention that these being given in the ordinary scientific wording there is no difficulty, excepting in the short introduction and title-page, to be overcome by those who (like myself) may find trustworthily translating what they may require from the Norse language an anxiously laborious task.

WASPS.

Common Ground-building Wasp. *Vespa vulgaris*, Linn.
Hornet. *Vespa crabro*, Linn.; and five other species.



Nest of Tree Wasp, after sketch from original specimen by Ed. Dimensions, 8 in. across by 7½ deep.*

The most remarkable insect appearance of the past season was that popularly known as the "Wasp plague." The very unusual prevalence of Wasp presence was reported from almost every one of the many localities in England, from which replies to my enquiries were forwarded to me, and though the infestation was not so general in Scotland, it was exceedingly troublesome over some large districts, notably by the Moray Firth; in the Lothians, and in some of the islands on the west of Scotland.

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* As the tenants of the nest were not identified at the time, I cannot say with certainty whether it is that of *Vespa sylvestris* or *V. norvegica*.

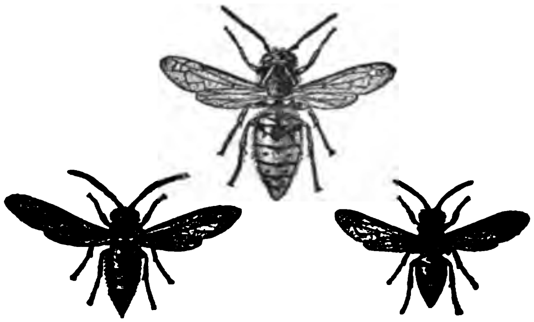
The enormous excess of Wasp presence above the average was in many places nothing short of a calamity, inflicting pain, and to some degree danger to ourselves, and to horses exposed to sudden attack, and great loss to fruit growers.

Within our houses, in many cases, the Wasps swarmed to such a degree, and especially at meal times, as to make their presence on the food a real trouble; the agricultural or garden labourers were severely stung where working on crops to which the Wasps had been attracted by presence of Aphides, as in Bean fields, or on fruit stocks, where budding was going forward. Also pain, risk, and delay in farm work, were caused by fierce onslaughts of Wasps from nests turned up in ploughing. Great losses were caused by the quantity of fruit entirely ruined up to almost wholesale destruction in the grounds of large fruit growers, and to this must be added losses to shop-owners dealing in such commodities as find favour in the eyes of the Wasps for their own consumption, or thievish abstraction for food of the coming on generation still in maggot condition, to be counted by hundreds, in each of the vast number of nests which were the head-quarters of the marauding and troublesome pests.

The question was frequently asked,—What was the cause of such an unusual visitation? and there appears no reason to doubt that the exceptional numbers were a consequence of the exceptionally favourable circumstances for Wasp life which was supplied by the early and long continued dry weather of the spring. Thus there were not the usually returning intervals of cold and wet to catch and destroy the queen Wasps when warmed into active life, and drawn out from their winter shelters by what, in most years, is an alternation of sunshine, with weather that leaves the houseless queens between whiles (and much to our benefit) exposed to just the conditions unfavourable to their own existence, and likewise to that of their embryo nests. Where these most fragile structures of just a cap of paper-like material, perhaps not an inch across, with a few eggs or maggots, as yet not sheltered around from inclement weather influences, are exposed to all the varieties of temperature and circumstances customary in March and April, we have a most serviceable preventive condition, which was not the case in the long settled drought of last spring, and of which we saw the consequences.

Before going on to the reports of the year, it may be of service to give as shortly as possible an account of the ordinary method of Wasp life in this country. That is, the history of the Wasp colonies from their rise, by the work of a single female in early spring, through the increase of tenants during the summer, up to many hundreds, or a few thousands, and the coincident enlargement of the paper nests, on to the decay and desertion of these nests in the autumn, when all that remains of the great summer family are a comparatively few females, commonly known as queens, which have left the nest and stored themselves away for their winter quietude in sheltering nooks to wait the spring sunshine for active life and labour.

Species of British Wasps.—In Britain we have seven species of social Wasps, that is, of Wasps living together in societies formed of males, females, and neuters, or abortive females, commonly known, respectively, as drones, queens, and workers.



VESPA VULGARIS.—Largest specimen, queen, or female; specimen to left-hand, with long horns, drone, or male; right-hand specimen, neuter, or worker.

The seven kinds of Wasps are divided into two sections of Ground Wasps and Tree Wasps, according to whether their nests are customarily formed in a hollow in the ground, or suspended in the air from a bough, or in a hedge, or, as with our largest species, the *Vespa crabro*, the splendid insect known as the "Hornet," the nests may be found in decayed trees, in roots, under eaves, or, as I have myself found it, down in the ground by a small post of a field paling.

The species of the Ground-building Wasps are the *Vespa vulgaris*, Linn. (see figure); the *V. germanica*, Fabr.; and the *V. rufa*, Linn., which is somewhat smaller, as regards the queens and workers, than the two preceding kinds, but variously marked, especially on the two first segments of the abdomen, with a red tinge. As I have seen it (especially on one occasion when, by mishap, I had to hold the entire colony of a disturbed nest down on the ground within my ring-net to enable my unwasp-protected colleague to escape), the difference in tint is a very fair general distinction.

Of the four species of "Tree Wasps," the most common are the *Vespa sylvestris*, Scop., and the *V. norvegica*, Fab. (the *V. britannica*, of Leach); of these the first is widely distributed, the second is not so common in England, but said to be abundant in Scotland. The *V. arborea* is so very rare that it hardly needs mention. I was, however, fortunate enough to find two specimens at Sedbury Park in the west part of Gloucestershire whilst observing and collecting to help my late brother, Dr. Ormerod, in the formation of his volume on 'British Social Wasps,'* which, on being submitted to the late Mr. Fred. Smith, of the British Museum, were identified by him as being queens of the *V. arborea.*

The *V. crabro*, or Hornet, is easily distinguishable from the other species of Wasps by its greater size, and its large proportion of rusty or reddish colouring. In the part of Gloucestershire mentioned above, where there was much woodland, it was not at all uncommon, but its range of habitat is given as not extending, as far as known, so far north as Yorkshire.†

VESPA CRABRO.—Hornet (queen).

In general habits it resembles the smaller Vespidæ, commonly known as Wasps, but by preference appears neither to build under ground, nor where exposed to weather in trees or hedges, but to select the inside of hollow trees, or logs, or roofs of lofts or sheds; the individual colonies are less in number than those of the Wasps, and the paper of which the nests are composed is much coarser. The nests sometimes run to a great size, the largest which I have seen, and assisted in securing when deserted in the winter, was taken from a cottage roof in Gloucestershire, and measured fifteen inches across, and nineteen inches in height, although some of the lower part had been removed.‡

The main points of Wasp life during the year, and the method of formation of the paper-like nests, are given shortly in the following pages as a guide to the customary life-history. For exceptional cases, or minute structural or anatomical details, the reader is referred to the many British and Continental publications on the Vespidæ.

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* 'British Social Wasps,' illustrated, by Edw. Latham Ormerod, M.D., p. 42, plate 3. Longmans, Green & Co., London.

† 'Brit. Mus. Catalogue of British Aculeate Hymenoptera,' by Fred. Smith, p. 222.

‡ See 'Social Wasps,' by Dr. Ormerod, p. 211.

The Wasp colonies of the year are begun by the large females, commonly known as queens, which have survived the winter, safely stored away in the sheltered localities which they chose for themselves when the nests to which they belonged were perishing in the previous autumn. Then the females select such places for their winter rest as dark nooks in sheds, or amongst wood, or rubbish, or dead leaves, or even amongst stones, or in a dry bank; indoors (if they can manage to escape observation) they will harbour in folds of curtains, toes of slippers, anywhere in fact that is snug and quiet, until they are turned out in the latter instances, or in the former, the return of warmth and sunshine wakes them from their winter sleep or torpor.

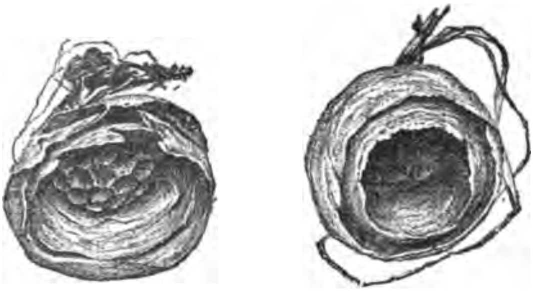
Then comes the point at which (as before mentioned) the state of the weather affects their powers of increase to a very important degree. Wasps are very sensitive to cold and exposure, and where weather varies, as is so commonly the case in early spring, from short bright sunshine to hard frost, or sleet and snow, many of the queens who are caught by the unfavourable weather perish, and the embryo nests, with their few eggs, or lately hatched grubs, are also destroyed.

This embryo nest, when the tiny structure has advanced so far as to have any definite form, may be described as much resembling a miniature open umbrella, made of thin grey paper-like material, from half an inch to an inch in diameter of the cap, and hung by the little stout peg above it to whatever support the queen Wasp may have chosen. Continuing the comparison to a miniature umbrella to give an idea of the entire shape, the stem above the circular cap forms the suspending point, the part below (somewhat like a short club-shaped handle) is enlarged at the bottom, and here a very few cells will be found containing each an egg or young maggot. Above these is the circular thin hood, or cap, which slightly protects the young family below from weather or chills.

This embryo nest is formed of a kind of grey paper made from morsels of wood, or of bark, or material of a similar kind, worked by the Wasp into a kind of paste, or papier maché, and spread into the required form by her jaws, and it is obvious that where this minutely delicate structure of perishable material is exposed to bad weather, it is most likely to perish.

Under ground, if it has been suspended in a hole, or under a clod, where wet could reach it, the paper is likely to be ruined, and the eggs destroyed; and similarly with the bush nest-building Wasps, the little nest is likely in wet and cold weather to come to nothing, independently of the chances of the mother Wasp coming to trouble, and thus the progeny being lost. In the exceptionally dry March of 1898, in which the returns show a rainfall of approximately one-third of the average, circumstances were exceptionally favourable both to the queens and to the safety of their families, and here it seems to me we have the reason for the correspondingly exceptionally vast numbers of these troublesome pests with which we were subsequently visited.

At first the queen has to carry on all the work of the commencing colony; to lay the eggs, feed the grubs, gather material for house-building, and use it herself for enlarging the roof of the family shelter, or for deepening the cells (which at first were little more than cups) so as to suit the needs of the growing grubs. Thus the first hood is enlarged, additional layers of paper are added, until the little nest begins to take its characteristic spherical form, and the few cells with which work began are increased in depth and numbers until they become a regular layer of paper Wasp-comb. The accompanying figures show this condition before the nest has been closed below, so as only to leave the requisite aperture for Wasp passage.



Wasps' nests in early stages, after photos by Dr. Ormerod.

From this time, if all goes well with the colony, the work goes on regularly. The queen continues to lay eggs, and the egg condition is stated to last eight days, the larva state thirteen or fourteen, and that of the pupa about ten; thus (speaking generally) in about a month from the time of the first eggs being laid, the first Wasps of the season begin to make their appearance. These are all abortive females, known as workers, and as they keep on developing in steady succession, from the succession of eggs laid by the queen, they carry on the labours of the rapidly increasing community. Successive tiers of horizontal comb, with cells on the lower sides, have to be built to receive the eggs and accommodate the grubs, and the outside of the nest has to be enlarged correspondingly, until, in the case of the common Wasps, it may be of a somewhat spherical shape of any size from two or three to eight or more inches in diameter. The Hornets' nest, as mentioned at p. 114, may be much larger, and also very likely not entirely spherical, but built against the side of a cavity in an old tree; also the paper is of a coarser kind.

The building of the outside of the nest is carried on by the workers stripping or rasping up small quantities of wood or vegetable material, and working these with moisture from their mouths into little pellets, which each worker carries home, as it is commonly described, in her jaws, but (from my own observation of the process) I should rather say *under them*, tucked, as it were, under her chin. Thus her jaws are free for work, and when she gets to her nest (in the case of a kind like that figured at the heading), then placing herself firmly in an inverted position, with three legs on each side of the edge of paper to be enlarged, she walks backward, spreading out her soft paper pellet with her jaws until it forms a little stripe securely joined to the former paper, but differing in colour according to the tint of the wood, or vegetable material, of which it has been made. In urgent need, as when removal of a turf had laid bare the top of a ground nest, I have known well worked up clay from some holes close at hand used to supply the much needed roof as quickly as possible.

The horizontal layers of comb within the nest are formed of the same kind of paper as the outside casing of the nest, each comb being suspended from the layer above it by short strong pillars of the Wasp-paper material, thus giving convenient room for traffic of the workers on the flat top of each comb whilst attending to the needs of the young family in the cells of the comb immediately above them. All the labours (excepting egg-laying), whether building, or repairing, fetching materials and food, clearing out rubbish, &c., have to be carried out by the workers, and in the case of ground-builders, the mere enlargement of the cavity to give room for the necessary enlargements of the family establishment is no small labour, and for those who can watch quietly it is a very pretty sight to observe the workers coming up from below laden, each one, with the little morsel of earth or pebble which was required to be excavated.

Towards autumn, the economy of the nest changes, males and females are produced, and shortly after the Wasp colony, as a social establishment, comes to an end. The drones, or males, having fulfilled their allotted work by pairing with the females, die, so also do the workers; the nest decays, and all that remains of the summer colonies and their quarters (excepting where nests may have been built in some dry locality where they are as safe as in a cabinet) are the females, which will leave the nest, and, hybernating in their selected shelters until spring comes round again, thus complete the year's circle of Wasp life.

Two points in the Wasp economy most important to us are their stings, and the nature of their food. It may be remarked that the females and workers are furnished with stings, but not the drones, or males, these are stingless. With regard to the food; taking it in the sense of what is carried off by the Wasps, partly for their own food, but to a large extent prepared in the inside of the workers before restoring it for the nourishment of the grubs, almost anything sweet or nutritious, and soft enough for abstraction, may be considered as serviceable. Animal food, as meat, fish, insects, in winged or maggot state, all are acceptable for the family larder; honey is a great attraction; jam, sugar, fruit, to any amount, are also all acceptable, in fact it is difficult to say what may not be laid under contribution for carriage home to feed the grubs, in prepared or unprepared condition. But irrespective of this point of what they may select to supply what, when under observation, appear the insatiable appetites of the larvæ, the workers on their own account (apparently) are greatly attracted by, and stand in need of, moisture. Here we have a point on which we may constantly base most successful measures for trapping and destroying them by myriads, and with regard to their wholesale depredations, and the dexterity and apparent powers of memory with which they carry on their minor thieveries, notes will be found in the succeeding observations.*

These in many cases contain reports of amount of presence, extent of damage caused, measures of prevention and remedy, besides other details of interest; but as in Wasp attack these are much affected by local circumstances, I have not divided the information for classing under different headings, but given each report entire, with, in some instances, a heading noting the chief point alluded, and have appended a general summary of the results to be gathered from the notes.

I have also added two or three short observations of amount of Wasp presence at a few Continental localities, for which I am indebted to the courtesy of entomological correspondents, duly acknowledged together with their kind contributions.

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* In my account of the general points of Wasp life and habits, I have written mainly from my own observations, taken some years ago, when collecting and observing to help my late brother, Dr. Edward L. Ormerod, whilst preparing his volume entitled 'Social Wasps,' regarding such points as required local attention in their own habitats; and also whilst collecting and preparing specimens of Wasps' nests for museum use at the South Kensington collection, then at Bethnal Green, under the curatorship of the late Andrew Murray, F.L.S. Under the circumstances, I was able to make a large amount of observations as to ordinary Wasp habits, and also experimentally, on such matters as applied to instincts under special emergences (arranged for them), rebuilding of abstracted nests, memory in regaining former localities, and also with regard to food. These, however, are unnecessary to be entered on here, but amongst the great number of publications on Wasp life, I may mention as a trustworthy work for consultation as to the number and distinction of our British species, the 'Brit. Museum Catalogue of British Aculeate Hymenoptera,' by the late Fred. Smith. Also that in Dr. Ormerod's work on 'Social Wasps,' a great amount of information is given from his personal researches regarding their external structure, and the internal development, both in larval and imago condition.—Ed.

Observations of contributors, arranged under headings of localities.

SCOTLAND.

I have preceded the other observations by the following communication with which I was favoured by my valued contributor for many years, Mr. Malcolm Dunn, The Gardens, Dalkeith Palace, Dalkeith, N.B., because, besides the record of special appearances, they draw attention in some degree to the reasons influencing amount of Wasp attack. Mr. Malcolm Dunn notes, from his own personal observations during a long course of years, and at localities respectively in England, Scotland, and Ireland, the preference of Wasps for dry situations, and dry soils; also mentions the special districts of attack during the past season in Scotland, and of the enormous amount of Wasp presence observed by himself during a part of August in various of the southerly and easterly counties of England; and also notes some applications serviceable for destroying the nests, including cyanide of potassium as the most effective remedy known, but requiring great care in use, it being a rank poison.

Mr. M. Dunn wrote me on the 28th of September as follows:—"Wasps.—They have been an unmitigated nuisance in many parts of the country this season, but as a rule they prevail most in the drier parts of the country, and on warm and well-drained soils; hence in my six years' experience in Ireland, I never knew of them being nearly so plentiful as in the drier parts of England and Scotland.

"I was in the Co. Wicklow in the hot and dry seasons of 1869, 1870, and 1871, and although it is about the driest part of Ireland, and on a limestone gravel sub-soil, the Wasps were never half the trouble to us that they were in the Teme Valley, in Worcestershire, where I lived for nearly four years before going to Ireland. Coming to Dalkeith in the warm summer of 1871, I found the Wasps literally *swarming* here, although, as mentioned above, they were not troublesome in Co. Wicklow.

"We had *enough* of them here this season; but still I have seen them very much worse in previous years; and speaking generally for the Lothians, we have had no great cause for complaint, and escaped with comparatively little damage to our fruit.

"In some parts of Scotland they were undoubtedly bad, particularly round the shores of the Moray Firth, a district that shares with the Lothians in being the driest parts of Scotland. I heard more complaints from that district than from all the rest of Scotland, and I think Mr. Charles Webster, The Gardens, Gordon Castle, Fochabers, N.B., would be able to furnish you with some notes on the severe attack the Wasps made on the fruit in that district.

"I was in the south of England for a fortnight last month, and in some parts of Surrey, Hants, Sussex, Kent, Essex, Middlesex, Herts, and Bucks, the country appeared to be a *perfect Wasps' nest.*

"A solution of *cyanide of potassium* is our *most effective* remedy; but being a *rank poison*, it must be carefully handled. Brimstone, gunpowder, gas-tar, paraffin, Stockholm tar, and other 'remedies,' are all more or less effective; but none are equal to the cyanide of potassium in its deadly effects on the Wasps, and with careful handling it is perfectly safe, and not costly."

MORAY, N.B.—The following notes, with which I was favoured on October 4th, by Mr. Charles Webster, Horticultural Superintendent for the Duke of Richmond and Gordon, from The Gardens, Gordon Castle, Fochabers, N.B., contain much useful information. The points particularly noted are, that no especially large number of Wasps had been observed in the spring; the enormous number, and great amount of damage to fruit, ranging in date from the end of July until the second week in September, when the first frost occurred; also some remarks on the unusually large number of tree nests, observed chiefly on Larch and Silver Fir; and also number of nests in a given length of dry stone dyke; likewise some notes on measures taken to trap the Wasps. Mr. C. Webster wrote as follows:—

"So far as my own observation goes, there was not an unusual number of queen Wasps in the spring, nor did the past winter seem more favourable to preserve insect life than many former ones. It was about the last days of July that my attention was first called to the plague of Wasps, by their attack on the wall Cherries. We could find no protection from their attack upon this fruit, a large proportion being consumed by them. Some of the trees, when the nets were shaken, had the appearance, for a few seconds, as if a swarm of Bees had come off.

"As the different sorts of wall fruit ripened, such as Apricots, Peaches, and especially Plums and Jargonelle Pears, it was attacked by swarms of them. Even hard Apples and Pears (which had been picked by birds), and quite devoid of saccharine matter, were fixed on as greedily as some of the softer fruits. The plague continued from the end of July to the second week in September, at which time we had our first frost, cutting up Dahlias, Begonias, and other tender plants, and also putting a check to the quantity of Wasps.

"During the height of the attack, many thousands were caught by means of glass traps and bottles containing some beer, which we had hung on to the branches. It was also necessary to cover the ventilators of the vineries to prevent their ingress, otherwise they would soon have destroyed a house of fruit.

"There is a dry stone dyke or wall which partly surrounds our kitchen garden, and in it a great many nests were found. In a space of ninety-six yards, twenty-three nests were destroyed, but no suitable place seemed to be unoccupied by them. More nests were found this year than usual in trees, chiefly Larch and Silver Fir, and many of the nests of large size, and should you desire a specimen, I do not think there would be much difficulty in procuring one."

DUMBARTONSHIRE, N.B.—The following short note from Helensburgh, Dumbartonshire, N.B., sent me by Mr. Robert Howie, on the 15th September, connects (like those of various other observers) a somewhat greater amount of Wasp presence than usual in that neighbourhood with the greater heat:—"As to Wasps, they are not at any time plentiful here. I think, however, we have had more of them than usual, although not by any means 'a plague.' I consider this quite accounted for by the greater heat we have enjoyed this season."

ARGYLLSHIRE, N.B.—More westerly, that is, in the Island of Islay, the Wasp presence was noticed as being much in excess of the usual amount of appearance, though not in the vast numbers in which the infestation occurred in many places.

In reply to my enquiries, Mr. R. Scot Skirving, of Foreland House, Island of Islay, Argyllshire, writing on the 14th of September, mentioned:—"We have had no such plagues as I have read of in the south of England"; . . . "but we have had our plague too. We have had twenty or thirty Wasps at least for one we have had in previous years. They invaded the house, and stung the ladies"; . . . "they jump up and fight the Wasps with a pocket-handkerchief, and so get stung."

Mr. Scot Skirving further noticed:—"During July, the Oban papers frequently referred to what they called the 'plague of Wasps all over.' They mentioned Mull as swarming with them." . . . "I think there is no difficulty in accounting for the great increase of insect life in Britain, it is the great heat we have had."

Relatively to his own observation of Tree-building Wasps, Mr. Skirving wrote me that in East Lothian he thought they nested in equal numbers in holes in the ground, and in trees; but that "at this place" (*i. e.*, the part of Islay under observation) he did not know of Wasps having been observed to build on a tree or bush. Later on, he kindly forwarded me the following letter on the subject, sent to him by Mr. P. R. Ballingal, of Eallabus, also in the Island of Islay, N.B., with the remark, that with him there were more woods and plantations to draw observation from, as well as shrubs and bushes.

Mr. Ballingal wrote as follows:—"Wasps.—This year they have been much more numerous than I have ever seen them, yet with you I would not say they have been a plague. The foresters told me early in the season they never saw so many nests before; and as to the garden fruit, they helped themselves to the most of it. I am surprised to hear you say you never saw a Wasps' byke in Islay; here they are very common, both in trees and ground"; . . . "about the size of a man's head is the largest I have seen, and commonly more of the size of a yellow Turnip."

ORKNEY.—My other north British observation was very satisfactory as to absence of Wasp presence, and was sent me in the following short note, on October 18th, by Mr. Thos. McDonald, from The Gardens, Balfour Castle, Isle of Orkney, in reply to my enquiries:—"I am happy to say that I have not seen a dozen Wasps during my sixteen years in Orkney.'

ENGLAND.

YORKS.—Beaumont Park Museum, Huddersfield. From Mr. S. L. Mosley, F.E.S., as a practical collector, as well as scientific entomologist, I had hoped just possibly to get a note of observation of the very rare *Vespa arborea;* but, as will be seen below, this was not the case, so that the only note of observation of this species in live condition which I can give in these pages, is from the specimens taken accidentally (not in connexion with their nest) by myself some years ago in Gloucestershire, and then identified by the late Fred. Smith, of the British Museum (see ante, p. 114).

Mr. Mosley wrote me:—"As to the Wasps, we have had a great many about during the summer, but not, I think, so bad as in the south. The great majority are *V. vulgaris*, but *V. sylvestris* is not uncommon. *V. crabro* does not occur here, though it has often been reported to me, but always turned out large female *vulgaris*, or nests of some of the tree species. I have never noticed *V. arborea*, not to know it."

Writing from Preston, Hull, Yorks, Mr. H. L. Leonard mentioned (as below) the great prevalence of Wasps in that neighbourhood, and also a method found serviceable for destroying the nests:—"Wasps.—We have had a most unusual quantity this year. A few years ago, I particularly noticed a very large number of 'pioneer' Wasps in the spring; these appeared to make for the kitchen, and were destroyed: during the summer following, I don't suppose I saw a score of Wasps in all. This spring, on the contrary, I only saw one 'pioneer' Wasp, and in the summer the ordinary Wasps were a positive pest, they were everywhere.

"Remedy.—I always fill an empty cartridge-case with about one part flour of sulphur to four parts of gunpowder, damp slightly, attach a lighted fuse, and place in the hole leading to where the swarm is located, in ten minutes every one will be suffocated."

NORFOLK.—The following notes with which I was favoured by Mr. Edw. A. Atmore, F.E.S., of King's Lynn, Norfolk, contain some very interesting observations on various points of the Wasp infestation. One of these is the trouble caused by them to men and horses in the fields; another the species of Wasps mainly noticed, and large proportion amongst these of the *V. vulgaris;* also the observations of the method of Wasps in dealing with flies and other insects; and the serviceableness of Hornets in destroying the common Wasps.

On the 4th of October, Mr. Atmore wrote me as follows:—"Wasps have been very abundant in this district, particularly in the fen or marshland districts, where their ravages amongst the fruit have been, I believe, unexampled. In the marshland districts of Lincolnshire, I am told, on good authority, that they have been even more abundant large numbers of nests frequently occurring within a very small area. Cyanide of potassium has been largely used here for the destruction of nests. I can only report the occurrence of four species here (of course excepting *Vespa crabro*, the Hornet), *viz.*, *V. vulgaris*, *V. germanica*, *V. rufa*, and *V. sylvestris.* Banks of streams and ditches have of course been more generally used by the ground species for nests; but many nests have occurred in old rockery of gardens, and beneath fences, and instances of nests in ground of open fields have also come to my notice. Nests in the latter situation have caused much trouble and annoyance to horses and men engaged in ploughing. Old roofs of houses have also been freely patronised for nests, especially by *V. germanica.* The nests of *V. vulgaris* have been most frequent: probably at least 80 per cent. of the nests here have been those of that species. *V. germanica* has been commoner than *V. rufa*, but nests of *V. sylvestris*, upon fruit trees and Currant bushes, have been fairly common. *V. sylvestris* generally is a rarity here, although I am aware it is generally common in the south.

"Wasps being so much to the fore this year, I have had opportunities now and again of making observations as to their insect-killing propensities. I have often seen them seize flies on the window with their mandibles, and retain them in the mouth for a long time as they fly round the room, or run up and down windows. I do not think that they generally kill flies as food for themselves, but I have watched them entering nests with flies and other insects, which seems to indicate that they are intended for consumption by their larvæ, or grubs.* Once I witnessed a Wasp seize a small white butterfly (*Pieris rapæ*) and carry it off, I suppose to its nest. Larvæ of Lepidoptera have also been destroyed by them here in large numbers; and certainly larvæ of Macro-Lepidoptera have not occurred this autumn in such numbers as I had expected to find them.

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* This view is entirely in accordance with the peculiarities of the internal structure of the Wasps in imago condition, and with what is shown as to the nature of a part of the food of the larvæ, by the undigested remains to be found in the blind pouch when moulted off. See observations under the heading of food, at the latter part of this paper.

"Hornets (*V. crabro*) have also been unusually plentiful here, the nests, as usual, occurring generally in hollow trees. These powerful insects seem to be as fond of destroying Wasps, as Wasps themselves are of destroying flies. I have several times witnessed this habit of theirs."

WORCESTERSHIRE.—On applying to Mr. J. Hiam, The Wren's Nest, Astwood Bank, near Redditch, with regard to what he might have observed of Hornet presence in the past season, he informed me that "Hornets," *Vespa crabro*, had been more numerous than ever remembered in that locality, and also for a few miles round. Eight nests had come under his own observation, and he had heard of others being taken at a short distance beyond the extent of his own walks.

Later on, on November 9th, Mr. Hiam favoured me with the results of his further enquiries as to amount of Hornets' nests observed, and damage done by the insects, as follows:—"I find there were about a score of nests within a few miles that were known of, and doubtless others in woods and lonely places would escape observation. Considerable damage was done in gentlemen's gardens to wall fruits of the best sorts, and also to fruit in orchards, and in the fields, to cider fruit; but the latter has been so plentiful and cheap, that it is hardly worth taking into account.

"I have taken a large quantity of queen Hornets from various nests, some of which I have alive now (November 9th). This will materially lessen the number of nests next season, but from what I know of several colonies in inaccessible positions, in roofs of houses and otherwise, a large increase may be expected."

Mr. Hiam further remarked with regard to the habit of the Hornets of stripping young bark:—"Near one Hornets' nest I noticed the young Ash sticks had been stripped in pieces of the bark all round, or in other cases in patches, which is not unusual, but for the exact purpose I am not quite certain, because the combs, and paper covering on the outside of nests, appear to be composed entirely of dead rotten wood, nicely blended in coloured layers. Hornets also take the sap oozing from wounds, whether caused by Hornets or otherwise, of the Elm, and also tap Dahlia stems, and suck the flowing sap."

Some very good figures of shoots of Ash, and also of Birch, injured by removal of bark by the Hornets, will be found at p. 405 of the valuable volume by Dr. J. Ritzema Bos on animals injurious and useful in agriculture, horticulture, &c.* Dr. Ritzema Bos, speaking on the following page of the damage done by Wasps (including in this of course Hornets) in this way, notes that although the building material is chiefly of rotten wood, they will gnaw down to the sap wood of young branches or stems for the purpose, apparently, not only of using the torn off pieces of the bark for building purposes, but that they may suck the sap that flows from the wound. Ash is mentioned as preferred; after this Willow, Alder, Birch, Beech, Lime, and Elder. (In an instance where I had myself, together with my sister, the opportunity of watching Hornets at their operations in removing patches of bark from some Ash saplings by a pool in Gloucestershire, we were able to see them definitely sucking in the sap from the torn edge of the bark.—Ed.) Necessarily, where much bark is taken, or the young bough, or sapling, completely ringed, much damage is done.

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* 'Tierische Schadlinge und Nützlinge fur Ackerbau,' &c., von Dr. J. Ritzema Bos. Paul Parey, Berlin.

Mr. J. Masters, Hon. Sec. of the Evesham Fruit-growers Experimental Committee, writing to me from Evesham on the 11th of Sept., in reply to my enquiries, observed :—"It is singular, but here in our immediate locality we have had no more Wasps than in ordinary years. This, my opinion, is confirmed by that of others.

"The men have taken the Hornets' nests this year in my orchard. The nests were built in the cavities of two old trees. The powder-ball, that is, the paste made of wetted gunpowder, was applied to the hole; this ignited the filth or decayed wood, which gradually burned the interior of the tree, and destroyed the nests. Of course it killed the tree. The usual method employed here in taking Wasps' nests, is by the fizzy, or powder-ball."

Gloucestershire.—The following note refers chiefly to removal of already disturbed Chafer grubs by Wasps. During the latter part of the summer, I received a good deal of communication from Miss Dobell, of Detmore, near Cheltenham, regarding Chafer grubs (see ante, pp. 26, 27), which were injuring the grass roots on her land to such an extent that she was employing some men and boys to collect the grubs, which they were doing in great numbers; and about the 10th of September, Miss Dobell wrote me as follows regarding the attacks of Wasps on the Chafer grubs when collected from under the grass :—"I have been much interested to see that Wasps are wild for the grubs, and seem to bite them in half just below the head, and carry off something out of them to their nests. The men said they killed lots in the tins in this way.

"Last night, at seven o'clock, I went into the field to see if there were more places to do, and pulled out three or four grubs, and put them on the open space; a Wasp came at once and killed the grub in the way I mention, flew away, and came back for more."

With regard to Wasps' nests, Miss Dobell mentioned that up to the date of writing (10th September) none but ground nests had been noticed this year; but of the ground nests numbers had been taken, and it was obvious many more nests must still be remaining, from the great number of Wasps that were still observable.

Mr. C. D. Wise, writing from the Toddington Orchard Company's Grounds, Winchcomb, mentioned:—"Wasps were a terrible nuisance to us in our vineries, and did an enormous amount of damage. I hope you will be able to give us some remedy."

Cornwall.—From Coosenwartha, Scorrier, Mr. Geo. Thomas wrote me, on the 7th of September, regarding Wasps:—"They never were so plentiful in this county as at present, indeed they are a nuisance." . . . "I used to destroy them by screwing paper thus" (here a sketch was given of a piece of paper twisted into a funnel-shape.—Ed.), "tarring the outside, and thrusting it in their holes, and in the night, pouring paraffin, and setting fire to it.

"But there are several kinds. The kind I am writing of we call the 'Apple-bee,' the abdomen is striped with yellow and black." Not being aware of this peculiar name for Wasps, I enquired of the daughter of a Cornish farmer resident here whether she had ever heard it, and she told me that until about four years ago (*i. e.*, until she came out of Cornwall), she never heard them called anything else. "There were Honey-bees and Apple-bees, and the Apple-bees built paper nests in hedges."—Ed.

Guernsey.—The following notes, with which I was favoured by Mr. F. Hutchesson, 1, Queen's Road, Guernsey, notice prevalence of Wasps beyond the usual amount in the island, but still not in numbers sufficient to do serious damage:—"I think we are singularly free of Wasps here; this year they have certainly plagued us more than usual, with the result of spoiling fruit, especially Figs and Plums. They have been more numerous than I ever remember, but their numbers would not, I think, have been considered out of the way in an ordinary season in England.

"I have never heard of a Wasps' nest in Guernsey in a bush; here they appear to prefer old banks, and as the fields are nearly always fenced by a bank, they do not make their nests where they could be disturbed by horses ploughing. In fact, I think I may say that although Wasps have been more plentiful than usual, they have done no material harm."

Kent.—The following notes refer to number of nests observed, and also to methods found to answer for destroying them, and were kindly sent me on the 2nd of October, in reply to my enquiries, by Mr. W. Gardner, of Bekesbourne, Kent:—"I have deferred writing to you re Wasps until I could get some fairly reliable information, and I may say the pests have been destroyed or taken (I cannot quite vouch for every one of them being destroyed) to the extent of nearly two hundred nests or, to speak more assuredly, between one hundred and eighty and one hundred and ninety.

"I think about half were taken, or supposed to be completely destroyed, by cyanide of potassium, mixed in the proportion of two ounces of cyanide to a pint of water; the others were destroyed by pouring in gas-tar, or a sulphur mixture, as they used to do formerly. My old gardener always used pieces of Elder tree, from which he had abstracted the pith, and they were filled with a proper admixture of brimstone, &c., but I have forgotten the proportion. They went off like a squib.

"My man who used the cyanide said it was wonderful to see the instantaneous effect it had on the Wasps, and we found that the best way was to give them some; the next day to catch the stragglers that had stayed out during the warm nights, and then dig them out, and crush all the hatching and unhatched larvæ. Indeed, even when using the tar, digging out is requisite to make sure of destroying them.

"I remember one case I had where the hole ran upwards, so I stopped the entrance, and then got a pointed iron rod, six or seven feet long, on which I put a piece of gas-pipe, about half the length or less, and then running the rod carefully into the ground, I soon found when I had come upon the nest. I then drew out the rod, and poured in a quantity of gas-tar, which effectively did its work.

"The cyanide process is very simple. We dip a piece of cotton wool in the mixture, and put it upon a pointed stick, and push it pretty well into the hole; of course it needs to be in the hands of a trustworthy person, being such a *violent poison*. Hornets, I am happy to say, I know nothing about, never having seen a Hornets' nest since quite a boy."

The above observations of numbers and treatment of Wasps' nests, were taken from an area of somewhat less than six hundred acres of ground, thus giving an average of somewhere about one Wasps' nest to every three acres.

From Canon Court, Wateringbury, Mr. Edward Goodwin gave me the following observations, which note, amongst other points of interest (more especially as coming from a Wasp and Bee observer), that queen Wasps were not, so far as noticed, more observed than usual in the spring; also the greater strength of the nests, both in size and number of tenants, and that the autumn disappearance commenced earlier than usual in the season.

Mr. Goodwin wrote:—"With regard to the so-called Wasp plague, I send you the following notes as the result of my own observations. I believe there were *not* more queen Wasps in the spring than usual, but the fine warm weather enabled a very large proportion of them to establish nests before being destroyed by their various enemies. But a far more noticeable feature than the number of nests, was the great strength (in number of Wasps) of each, the average size being larger than I have ever known before.

"We made a great onslaught on them in June; most people using cyanide of potassium, which I have myself used successfully for years. At one time they were certainly quite a plague. A large quantity of fruit of all sorts was destroyed by them, and few people escaped being stung.

"Undoubtedly Wasps do a certain amount of good in killing flies and other insects, but in my opinion it bears a very small proportion to the amount of harm. The autumn dwindling commenced unusually early,—at the beginning of August, or even sooner."

In the neighbourhood of Farningham, a little village near Southfield, Dartford, Kent, three dozen nests were found within a radius of a quarter of a mile, and taken with turpentine and paraffin. (Contributed by Mr. F. O. Solomon, Lecturer in Agriculture of Durham College of Science.)

SURREY.—Birtley, Witley. The following note refers to one of the worst accidents from Wasp attack to horses of which I heard, and of this such exaggerated accounts were circulated, that on application to him as to what really had occurred, Mr. Thomas Collins, the Agent for the Earl of Derby, at the above address, kindly contributed the following information:—"The only way in which the Wasps have interferred with our agricultural operations, so far as I know, is by driving the horses and men from their work.

"We have ploughed through a great many nests; but on one occasion the horses were so stung that they tried to get away, and one of them fell into a narrow ditch just close to a tree, and the men had to cut the tree down to get the horse out, and even then, as he was on his back and could not turn, he had to be pulled out by main force. We found he had been stung in more than twenty places. His partner fared a little better, as we could find only about a dozen bumps on him. The man who was with the horses, and another who ran to his assistance, both got severely stung about the head and neck."

(Observations as to the inconvenience caused by attacks of the Wasps to horses and men, will be found in the report of Mr. Charles Robinson, of Beeding (p. 129), and mentioned by other contributors. —ED.)

The Gardens, Lythe Hill, Haslemere, Surrey. Mr. Evans, a very careful and experienced observer, writing on September 9th, mentions the enormous prevalence of the pests, their early appearance, the damage caused there, the great number of nests, and effectiveness of cyanide of potassium for getting rid of them:—"In answer to your enquiry respecting damage, &c., of Wasps, I beg to inform you that never in my experience in various parts of the kingdom have they done so much damage. The early dry hot spring brought out the queens at such an unusually early date, that the development of brood was strengthened. I may note that on March 27th, I took a nest from a Thuja tree, two inches by one and three-quarter inches, since that time one hundred and twenty-seven nests have been taken within the gardens. I have not found anything so effectual and easy as cyanide of potassium. The Gooseberry crop was completely cleared when approaching ripeness; quite two-thirds of the Pears have been damaged and destroyed; Apples about one-third; Plums about half." *

SUSSEX.—The following notes, kindly contributed by Mr. Charles Robinson, of Truleigh, Beeding, refer especially to farm damage, and inconvenience caused by Wasps, in respect of attacks on horses, and also in stings to labourers in the field; and likewise to benefit from Wasps destroying flies in cattle sheds, points on which Mr. Robinson's large occupancy of ground, amounting to two thousand acres, on the Sussex downs, near Brighton, gave him full opportunity of observation. Mr. Robinson wrote as follows:—"It is a fact that we have had a full share of the 'Wasp plague' in this part of Sussex, but except incidentally, I do not think that agriculture (as the term is generally understood) has suffered thereby.

"There have been several instances hereabouts of teams having been driven from the field when they have trod on, or ploughed up, Wasps' nests; and our Bean cutters got sadly stung at their work, it being almost impossible to handle the crop without also handling the Wasps that settled in vast numbers upon the Bean plants. Their object was evidently the pursuit of the Aphides with which the Beans were this year infested, and in preying upon these they were helping to rid the farmer of a most destructive enemy, though apparently they made but a small impression on the vast number of Aphides.

"The Wasps unquestionably destroy a great number of flies about the cattle-stalls, &c. I believe they prefer the blood-sucking variety, and often get these when they are gorged with freshly drawn blood from the beasts. The clumsiness of the Wasp in pursuit of active flies is sometimes curiously apparent, and if a door in the bright sunshine happens to be studded with nail-heads, about the size of flies, Wasps may often be seen trying to seize them.

"The 'real damage' they have done, and are doing, is to fruit, particularly Pears, and the higher qualities of Apples. Many of these

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* Mr. T. P. Newman, of Hazelhurst, Haslemere, to whose kind co-operation I am indebted for procuring me most of the foregoing and following reports on Wasp presence in Surrey and Sussex, mentioned to me that the above Wasp damage was notwithstanding Mr. Evans having many thousand bags placed on the fruit.

latter are decaying and falling from being pierced by the insects." . . . . "Since the Blackberry crop has ripened, I think the damage in orchards has somewhat decreased."—(C. R.)

Lowfield Nurseries, Crawley, Sussex. The following notes, contributed by Mr. J. Cheal, from the above address, give details of the severe damage caused by Wasps to fruit, as well as some observations as to their method of carrying on the ravages, and also (as in the two preceding reports) inconvenience from attack out of ploughed-up nests, and to men working on Aphis infested plants from Wasps attracted by them. Mr. Cheal noted:—"In the first place as to damage done by Wasps, we have had unusual opportunities of observing their habits this season, as we never before knew them so numerous.

"We have destroyed within the nursery over two hundred nests. There is no denying but that they have done a large amount of damage to the fruit, and we have now lying upon the ground underneath some of the Apple trees, large quantities of Apple skins, which have been completely hollowed out by the Wasps, scores of bushels having been destroyed. We have observed them very closely, but we have come to the conclusion that in no case could we positively say that the Wasps *commenced* the fruit unless the rind had been punctured in some way before.

"We have here a large number of birds, and the Wasps generally attack an Apple that has been previously pecked by them. This year we have also noticed that the Apples have been attacked by a large number of *small* birds, such as tits, and this has given the Wasps a greater opportunity of penetrating the fruit, but they have been by no means slow in taking advantage of previous depredations. They also appear to have a decided preference for certain *varieties* of Apples, and we were somewhat struck this year with the way in which, for a few days, they would swarm upon *one* variety, and then suddenly leave this for some other variety, which appeared to be more to their taste; so much for Apples.

"As to Plums they did a considerable amount of damage to these, and there is no doubt that they punctured these without assistance from birds, &c. We had, in consequence, to gather many of our Plums before they were fully ripe. Grapes they have also very much damaged, and it has been needful to cover all openings in the houses with fine net, in order to exclude them.

"We think we should, in fairness to the Wasps, mention *one* instance in which we think their presence has been beneficial. The fruit stocks, especially Apples, have been very heavily attacked by Green Fly, and the growth of the plants being somewhat slow owing to the drought, these Aphides have also severely checked their growth, and we noticed during the prevalence of the Wasps, that they swarmed upon these plants, and fed upon the Aphides. So thickly have they swarmed upon these fruit stocks, that our men in budding them have been frequently stung. We do not know of any operations having to be suspended in consequence of Wasps, and the only other serious interruption that we have heard of has been by the occasional ploughing up of a nest. Our own men did this once or twice, and in one case, the nest being a strong one, caused the horses to bolt, in consequence of the stings.

"The only remedy that we have tried, has been the destroying of the nests by either tar or cyanide of potassium.

"While upon the subject of Wasps, I may mention that we found in our nursery a fine specimen of the Tree Wasp (*Vespa norvegica*), which had built their nest upon a branch of Norway Spruce. I enclose a photograph of the nest."—(J. C.)

Estate Office, Maresfield Park, near Uckfield, Sussex. Mr. Mark Sandford, with whom I was also in communication regarding attack of Rose Chafer grubs (see p. 26), contributed notes of great numbers of nests being observed, and very serious damage to fruit, as follows: —"In reply to your enquiry as to Wasps, I should think three hundred nests have probably been taken near us, say on three hundred acres of land. I have heard of no hanging nests. Heavy losses have been sustained, as some best fruits have been utterly eaten up; all our Peaches were eaten before they were ripe, we could *not ripen a single one*. All our out-door Grapes were eaten, and many of our best eating Apples cleared out, leaving only the peeling.

"Our men have taken many nests with torches made of gunpowder and tar, put in the holes, and set alight."—(M. S.)

At Hollycombe, Sussex (post town, Liphook), the severity of the attack was still greater. I am indebted for the following contribution of information regarding this, which I think was about the worst of all the cases reported in presence of nests, besides damage to men and horses, to Mr. T. P. Newman, of Hazelhurst, Haslemere, who procured it for me, and wrote:—"Mr. J. Clark Hawkshaw, of Hollycombe, Sussex, reports that his bailiff has paid sixpence each for three hundred and seventy-six Wasps' nests taken within half a mile of his kitchen garden: an additional payment was made afterwards for ninety-four more, some within the half-mile, and the remainder a little further away: four hundred and seventy in all. The damage to fruit, and especially to Grapes in the houses, was very great.

"Ploughing was stopped on one occasion, twenty nests being ploughed up in one field, and both horses and men were badly stung." —(T. P. N.)

OXFORDSHIRE.—Kidmore Grange, Caversham. The following few lines, with which I was favoured by Mr. Martin J. Sutton, from the above address, are in reply to an enquiry of my own, whether the great complaints regarding Wasp presence were over-stated, and show the prevalence of the pest in that as in many other localities. Mr. Sutton wrote me:—"There is no doubt whatever as to the 'Wasp plague' having been most serious, fruit having been destroyed wholesale, and people being in fear of their lives from the invasions of their houses by these pests. So numerous have they been at our own table, that it was difficult to take food on our fork without putting a Wasp in the mouth."

HERTS.—St Albans, Torrington House. Although in my own house I believe we were much less plagued than in many other places, I can bear witness to the Wasps being exceedingly troublesome, and at mealtimes a dextrous well-aimed pat with the back of a spoon, which would send the pest down without escape into the syrup, or whatever it might be, on which it was trying to maraud, was much too often required. Thus the Wasp is incapacitated for a minute, and may be picked out and destroyed. A neighbour, however, was in some danger from a sting of a Wasp, given inside the throat whilst being swallowed in some beer.

In the town, the Wasps were excessively troublesome. At the Misses Randall's, one of the chief stationer's shops, the Wasps flocked in in such numbers, that for comfort of the customers the doors were obliged to be kept as much shut as could be managed.

Mr. Strofton, of Chequer Street, St. Albans, one of the leading grocers of the town, informed me that he had not known the Wasps so troublesome for many years as they had been in the past season. They swarmed in at the door in vast numbers, and got into the sugar drawers, and carried it off in quantities, amounting altogether to some pounds. The jam-pots also were ravaged at where open to attack, and often cleared out some inches down. By way of trying an experiment as to extent of plundering, Mr. Strofton took the cover off a 2 lb. pot of jam, and left it exposed, and by the following night the whole contents had been removed. The Wasps had not given much annoyance by stinging, neither had they done any observable amount of good as to clearing away flies.

They appeared to have as good knowledge and memory in finding their way to the sugar drawer as in finding their way back to the nest, for whilst I was enquiring as to their habits, a Wasp flew in at the door, went behind the counter, and, before I could move a few steps to watch operations, had made its way into a sugar drawer.

Mr. Strofton informed me that the method of trapping he found answer best, was to partly fill rather small bottles, such as soda water bottles, with a mixture of beer and sugar boiled together, thus he had caught quarts of the plunderers.—ED.

At the butcher's with whom I deal (Mr. Steabbens of the Market Cross), who has a large shop, the Wasps were unusually plentiful. They were said especially to come to the newly cut meat as, for instance, to the freshly cut end of a leg of mutton. They had not been observed to show any particular preference for liver, but sheeps' hearts especially attracted them. In reply to my enquiry whether they merely sucked the juices, or carried off pieces of the meat, the reply was, "Oh, pieces.". They were not considered to have lessened amount of flies, certainly not of blow-flies.—Ed.

IRELAND.

Kylemore Castle Gardens, Kylemore, Co. Galway.—On the 5th of October, Mr. W. Farmer, writing from the above address regarding the presence of Wasps in the above district during the past summer, mentioned:—"Wasps have been unusually plentiful here this year, but as a rule they are very scarce, causing but little damage to fruit crops, and although they have been unusually plentiful this year, they cannot be called a pest, attacking only damaged Plums, over-ripe Gooseberries, &c. I know of only two nests, but as they have been in no way troublesome, I have not looked particularly for them.

"The wet boggy nature of this district, and the heavy average rainfall we have here, no doubt keep the Wasps very scarce here."

From the Connemara Basket Industry, Letterfrack, Co. Galway, a locality very near the above mentioned, Miss Sturge replied to my enquiries as to Wasp appearances, on the 22nd of September, as follows:—"With regard to the question of Wasps, we have had very few this summer here, for there is no fruit in Connemara, and the winds do not suit the Wasps very well." Miss Sturge also mentioned that about two miles off, where there was a large garden, and more shelter and cover for the Wasps, and also more trees, she had seen a number of Wasps' nests in the ground. "Here," Miss Sturge remarked, "I am on the bog-land, unsurrounded by trees, and without anything for Wasps to feed on."

A few Continental observations of Wasp presence.

NETHERLANDS.

State Agricultural College, Wageningen. On the 20th of October, Dr. J. Ritzema Bos, Professor at the State Agricultural College, was good enough to tell me, in reply to my enquiries, that:—"Wasps were also very inconveniently prevalent in the Netherlands, and also in Germany, at least in the Harz, where we were in August.

"*Vespa vulgaris*, *V. germanica*, and *V. media*, were very prevalent here, indeed the Grapes were eaten by them on a large scale"; also, in one place, a little boy died in consequence of being stung by a great number of *Vespa crabro* (our English Hornet).

NORWAY.

CHRISTIANIA.—Dr. Schöyen, State Entomologist, Christiania, was also good enough (on the 31st of October) to send me the following information, to which he added a most interesting account of such unusual prevalence of Wasps some few years back so far north in the Arctic circle, that I have great pleasure in inserting it, with many thanks also for Dr. Schöyen's spirited translation. Later on, Dr. Schöyen favoured me with some further observation of Wasp presence in a more southerly part of Norway during 1893.

Dr. Schöyen wrote me first on October 31st:—"As to the Wasps, they have not, so far as I know, been troublesome this year in our country. Last year they were more numerous than in this year, at least here in the south-eastern districts of Norway, indeed more than usual abundant, though not in such excessive numbers as sometimes may happen even in more northern localities.

"In the years 1883—1884, there was quite an unusual prevalence of them in the Arctic Norway, especially at Tromsö and other islands in the vicinity. Mr. J. S. Schneider, Conservator at Tromsö Museum, writes in the Swedish 'Entomologiste Tidskrift,' 1885, pp. 148, 149, about this matter as follows:—'Who can tell all the tears which these wicked animals have squeezed from the poor children, or the swearings which the mowers have thrown out, the half-shut eyes, and the swollen hands and cheeks, which have shown forth in the autumn months of these two years? Perhaps this may appear as an exaggeration, but it comes, however, pretty near the truth. They built their nests everywhere, in the earth, in stone walls, behind the wainscottings of the houses, under garden benches, on the trees; it swarmed with Wasps on all the flowers and bushes, the windows were filled with them, they crawled on the plates of the dining-tables, licked of the dishes with preserves, crawled under the clothings, and in the hair, and did not at all spare the ladies! When one was going in the woods, a humming warbling was heard, which is still sounding in my ears; Wasps everywhere, it was almost a despair,' &c.

"I have not in the southern districts of our country anywhere seen the Wasps so exceedingly numerous as they must have been in Tromsö in the said years. The species occurring here are: *Vespa crabro*, *media*, *saxonica*, and var. *norvegica*, *holsatica*, *vulgaris*, *germanica*, *rufa*, and *Pseudovespa austriaca*."—(W. M. S.)

V. holsatica, of Fab., is one of the synonyms for our own *V. sylvestris*, Scop.; our *V. norvegica*, Fab., is also the *V. britannica*, of Leach.

At the beginning of December, Dr. Schöyen kindly sent me the results of some subsequent information received as to the unusual prevalence of Wasps in the past season, and the damage done by them, especially to Cherries in the neighbourhood of Laurvik, a town about sixty-five miles S. S. W. of Christiania, as follows:—" . . . I have also a short communication to give you about the Wasps. As I told you before they have not this year been unusually abundant here in the neighbourhood of Christiania, but now I have been informed that they have been so in the neighbourhood of the town Laurvik (more southwards), where they have done considerable damage upon the Morel trees, eating away all the fruits, and leaving only the stones. Such damage has not been observed in the place since many years, but the Wasps were this summer flying most plentifully in the trees."—(W. M. S.)

GENERAL SUMMARY.

The foregoing British observations show presence of all of our seven kinds of Vespidæ, commonly known as "Wasps" (excepting of the rare *V. arborea*). Of these, the *V. vulgaris*, or Common Ground Wasp, appears to have been the most observed, although both the other kinds of Ground Wasps, *V. germanica*, and *V. rufa*, were present. Of the Tree Wasps, the *V. sylvestris*, was noted by two entomological observers, respectively, as not uncommon, and as fairly common, and a nest of the *V. norvegica* was also reported. The *V. crabro*, the Hornet (a true Wasp, although not popularly considered as such), was "plentiful" in some localities, but only reported from a few.

The Wasps' nests, besides being much more numerous than in ordinary years, were noticed in some instances as being of greater than the customary size, and more numerously tenanted. From contributors who especially attended to the numbers of nests destroyed, or kindly obtained information for me, I had notes of destruction of over one hundred and eighty nests on somewhat less than six hundred acres of land; two hundred nests taken in one nursery garden; an estimate of about three hundred nests taken on three hundred acres; and in one instance, where a bonus of sixpence per nest was given, three hundred and seventy-six nests were taken within half a mile of the kitchen garden, which was the centre of operations, and later on payment was made for ninety-four more, within the same area, or a little further away,—four hundred and seventy in all. Other notes gave twenty nests ploughed up in one field; three dozen observed, or taken, in the radius of a quarter of a mile; twenty-three nests in ninety-six yards of dry stone wall, or dyke, &c. Of Hornets, in one locality, nine nests were known of within the limits of "a ramble," and twenty in the more extended area of a few miles.

It is worth noting, that from two well qualified observers respectively almost at the north and almost at the south of the area reported from, namely, localities in Co. Moray, N.B., and Kent, and also from a station midway, namely, Hull, I had information that *no* unusual amount of appearance of queens in spring preceded the very unusual amount of Wasp infestation afterwards.

Where the observers expressed an opinion as to the cause of the very unusual prevalence, it was referred, as indeed seemed clearly demonstrated, to the unusual weather in the spring being so entirely suitable for satisfactory settlement of the queens.

In some places the attack was noticed as passing away before the customary time of Wasp disappearance in ordinary years. In regard to *benefit* or *injuries* received from the Wasp presence, the evidence shows unquestionably preponderance of the latter.

We have some benefit from the Vespidæ destroying other insects, thus Hornets kill Wasps, Wasps kill flies and other insects, and insects in the maggot stage, if of kinds acceptable to them, or like the Chafer grubs, mentioned at p. 125, if exposed so that the grubs are accessible. Two notes are given of service in attacking Aphides, but in one of these it is mentioned that the Wasp attack apparently made but a small impression on the amount of the Aphides; and that the labourers amongst the Bean crop got "sadly stung"; and in the other, stinging of the workmen is mentioned as "frequently" taking place.

Taking flies round the cattle stalls is mentioned by one observer, but though doubtless they may do good by clearing flies in butchers' shops, I have no observations sent in of the Wasps giving themselves the trouble to collect food of this kind where juicy fresh cut surfaces of meat, or where (as in grocers' shops) sugar and jam, or other acceptable provisions, were more easily attainable, and (where I had opportunity of enquiring) no good service of the Wasps in this way had been noticed.

The great amount of injury inflicted by them in serious losses to fruit-growers, and pain, risk, and inconvenience, by their extraordinary amount of infestation in houses, and their attacks (or onslaughts, rather) on men and horses when disturbed in the fields, are matters of very demonstrable evil. Notes of these being given in the foregoing pages, it is unnecessary to repeat them; but where good fruit, and it will be noticed how, in some instances, the best sorts and choicest kinds are selected, is destroyed in bushels; bags used by thousands to protect it, and possible entrances into fruit-houses, or vineries, secured by netting, &c., that there is very demonstrable loss and trouble.

The applications named as useful in destroying nests are brimstone, gunpowder, gunpowder and sulphur damped, and fired so as to suffocate the swarm if in the ground, gas-tar, Stockholm tar, paraffin, and cyanide of potassium. Obviously any kind of application which will destroy the Wasps without allowing exit of the irritated legions to sting the operator, will serve the purpose, in case this is not accompanied by danger, as from use of gunpowder in careless hands, or what is a still more serious danger, the risk from use of deadly poison without proper precaution. Cyanide of potassium is certainly reported as the most approved remedy, but its deadly nature as a poison requires most careful consideration. The store of it should always be kept under lock and key, and whether used dry or in solution, the packet or bottle should always have a large and legible label POISON, and the application should be always entrusted to known careful hands.

Very often destroying Wasps' nests is a bit of amusement at odd times to any boys that may be about, and the more smell, and fire, and noise that can be made, the greater the pleasure. But for quiet, safe work that is effective in destroying the nest, I have found sending a man round with a pot of tar, and having a ladle of it poured down the holes, answer very well. If properly applied, no Wasps can get up to sting the applier, and the Wasps within die of starvation. In case, as sometimes happens, there are two roads down to the nest, this matter must be looked to, but I have generally found it answer well.

No method of taking hanging Wasps' nests has been given in the preceding notes, and the rough practice of burning the nest, and a portion of the hedge with it, is entirely objectionable. I have often taken them with perfect safety myself by simply having strong tan leather gauntlet-topped gloves, with linen tops sewed on to them, down which I could pass my hands, and then had these tops safely tied round over my sleeves between the elbow and wrist. Thus no Wasps could hurt my hands, and my head was defended by a large strong piece of muslin thrown over the top of a broad-brimmed hat, so that it hung well down all round, and the lower edge was securely fastened by pins round the shoulders and across the chest.

It is necessary to have a broad-brimmed hat to keep the sort of veil well off the face and nose, and for material, I preferred the patterned muslin, or net, or lace, as it is called, of an old window-curtain, for the differences in material, and different thickness, prevented the first rush of all the Wasps striking so directly and audibly at my hat. It may be that some people would not mind it, but the first minute of work with hundreds of Wasps endeavouring to sting was always a time of intense nervousness. I would not advise anyone to try the experiment unless they can be thoroughly trustworthily pinned up, or the results may be serious. But for common purposes, the plan often saves a deal of trouble if a nest is wanted out of the way at once, and the convenience of people who may possess bee-dresses, and will lend their services, are not at hand.

If, as may very likely be the case, the disestablished Wasps start a new house, as near as possible to the site of the former one, this will require destroying. In the course of experimental observation, I have known the Wasps of a removed nest rebuild from the very beginning four times, but never more than this, and these re-establishments are not of the importance of the original home.*

For catching Wasps, no plan seems to succeed better than hanging bottles (as noted by observers) partly filled with a mixture of beer and sugar. But where there are long ranges of Peach walls, or walls with fruit such as the Wasps delight in, I have seen glass-traps also answer very well indeed. These were made by taking a common square hand-glass with a pointed top, and a finger-hole just at the highest part. This glass was set on four bricks, one beneath each corner, so as to raise the glass by the depth of the brick from the ground, *not* by the width, which would allow too much space. On this lowest glass another is placed, taking care that any opening round the edge, where the upper glass rests on the lower one, is well closed with moss, and the finger-hole at the top of the upper one (*not* of the lower one) also carefully closed.

All that is further needed is to throw some fruit, such as the Wasps like, beneath the trap. The Wasps will go to it readily through the opening between the glass and the ground, but coming away is a very different matter. Then they usually fly upwards, and, passing through the open finger-hole into the upper glass, they are trapped, and perish. I have seen a deep layer of flies and Wasps thus trapped, to the great saving of the fruit on the adjacent trees.

For prevention of entry of Wasps into vineries, though the necessity of the matter is alluded to in the foregoing observations, no precise details have been given, I have known it answer quite well to fasten muslin, such as old window-curtains, to the edges of the lights and the framework to which they fitted when the lights were closed. If this is done carefully, there is little damage from the tacks (used to fasten the muslin) to either the paint or wood-work, but care must be taken to allow plenty of muslin, or the lights will necessarily not open as wide as is needed. Also the muslin must be so arranged as not to get in the way of the lights being closed, or to allow apertures which the Wasps will almost certainly discover.

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* No observations have been sent in on one point which touches us all very nearly,—how best to lessen pain and injury from stings; therefore the following extract from the work of my brother, Dr. Ormerod, on Wasps, may be of interest:—"Ammonia or soda will sometimes relieve the pain, and chloroform more certainly and speedily should it be at hand. Ipecacuanha is a favourite Indian remedy. But the best way is gently to withdraw the sting, and suck the wound if we can get at it, and then to leave it alone. Some persons swell very much after a sting, and for these rest, and a good dose of purgative medicine, are the best remedies." Some few words are added on the importance of leaving the wound itself alone, that is, not teasing or squeezing the part. See 'British Social Wasps,' by Edw. L. Ormerod, M.D., p. 14.

The food of the Wasps, taken in the straightforward common sense view of what they swallow, or carry off, we all know well. For this, insects in perfect or maggot state, whole or chopped up for convenience of carriage, are a regular article of consumption; meat also is used, and I have myself watched a Wasp carefully detach a filament of herring, and pack the long piece away into a small parcel beneath what may be called its chin, for transportation. Fruit, sugar, sweets, and other edible materials, and for definite drink, a sip of beer, or beer and sugar, are all notable articles of dietary, and so also, to the sorrow of our bee-keepers, is honey. Also in the case of the large species, known as Hornets, the juice flowing from young bark, which they have gnawed down to the quick, forms an additional article of diet, given by an additional department of mischief.

But though the distinction is fine between an article of food swallowed for the creature's own use, and an article of food swallowed and wholly or partially restored for use of the young which require victuals (and also victuals more or less prepared) to be brought to them, still this point has to be considered in regard to Wasp food.

Researches have shown that in the larva of the Wasp, the food canal, or bowel, has not an external vent, but opens into a blind pouch, and it is stated that when this, with its black contents, are thrown off, as at the second moult of the grub, this mass will be found to be composed of various substances, amongst which scales, hairs, and other fragments of insects, and hairs of vegetables, are recognizable.*

I have not myself seen the operation (said to take place) of the nurse Wasps, or workers, restoring drops of their collected prey from their own insides, and administering the proceeds in small drops to the maggots; but from my own experience in Wasp larva feeding, they seemed quite ready to swallow anything pleasant and available.

Those who wish to follow these matters up, will find them, and almost everything that can be thought of in Wasp economy, in the various special papers that have been issued for a great length of time, successively filling in the wanting points of the previous observations. In such of the preceding notes as refer especially to life-history, I wish it to be particularly to be borne in mind by my readers that I have only given a bare outline of the Wasp economy. To enter on details of lesser females, under what circumstances the young of a nest replacing a destroyed one may produce only drones, and really countless details besides, would be out of place here. Neither has it seemed desirable to enter on the Wasp parasites, which play a helpful part in keeping them in check, and especially the "Wasp-nest Beetle," as it is sometimes called, the *Rhipiphorus paradoxus*, of which the larva feeds on the young Wasp larva in its cell, and changes to beetle condition there, so that when in due course the Wasp should be expected to come forth, instead there appears this singularly shaped beetle, with its long compressed body, wing-cases shorter than the body, and separated from each other at their pointed tips, and also not covering the wings up to their extremities. These are, or were, formerly considered to be of rare occurrence, but where a Ground Wasps' nest had from some cause or other passed the ordinary bounds of size, I found them once in great numbers, and a few elsewhere.

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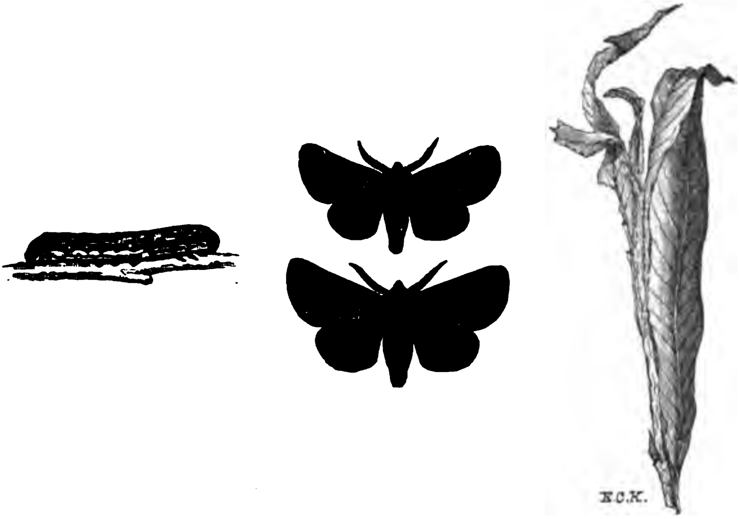
* See 'Social Wasps,' by Dr. Ormerod (previously quoted), p. 227.

To some who are not called on to suffer in person or in pocket,—who have leisure to sit quietly, so as not to "*molest*" the Wasps, and whose daily bread does not depend on working, hot in person and hurried, and irrespective of Wasp presence and convenience, or whose property is made off with, and their staff of men and horses perilled,—it may appear a proof of fine feeling to talk, or write, of the tender affection of the Wasps for their young, and their *un*paid labours. But to those who are otherwise situated the case appears materially different, and I should certainly say that where other means fail (in cases of great infestation like that of last year, namely 1898) it is well worth while to offer a bounty of a few pence per nest destroyed, which is a method of prevention and remedy which often answers very much more effectually than more elaborate arrangements.

P.S.—In the course of conversation with Mr. G. H. Carpenter, Consulting Entomologist of the Department of Agriculture of the Royal Dublin Society, Kildare Street, Dublin, whilst the above pages were going through press, he drew my attention to two females of the rare *Vespa arborea*, of which species the presence had not been previously recorded in Ireland, having been sent to him in the past season, 1898. The specimens were amongst a number of female Wasps captured in April and May by Mr. R. M. Barrington, near Bray, Co. Wicklow, and forwarded by him to Mr. Carpenter. The specimens were subsequently examined by Mr. E. Saunders, and considered by him to be "certainly" *V. arborea*. For the above information, with notes by Mr. Saunders, see also Ent. Mo. Mag. for July, 1898, pp. 166, 167.

WILLOW.

Small Chocolate-tip Moth. *Clostera reclusa*, Fbr.; *Clostera pigra*, Hufn.



Clostera reclusa.—Moth; caterpillar (after W. Buckler); cocoon of spun-up leaves from life.

On the 8th of June, Miss Sturge, of the Connemara Basket Industry, Letterfrack, Co. Galway, Ireland, wrote to consult me regarding insect injury that had appeared amongst her Osiers. Miss Sturge mentioned:—"I have been advised to ask you if you could tell me how to deal with a small grub that has attacked, and is, I fear, destroying, my fine Osier crop. I am living in Connemara for the purpose of starting a basket industry amongst the people.

"I have been trying the experiment of planting some of the finer varieties of Osiers on my land in order to avoid having to import them. The dry weather does not suit them, and lately they are covered with this soft white sticky stuff like soap-suds. I am afraid they will all get destroyed."—(S. S.)

On examining the specimens sent, I found that two attacks were present. One was that of the "Cuckoo-spit" insect; but it was obvious, from the condition of the leaves, that something which was devouring these was also present, and I begged for further specimens. These Miss Sturge sent me on June 20th, and left no doubt as to presence of "Cuckoo-spit." The other attack was of a small black, grey and yellow moth caterpillar, which seemed to have been damaging the leaves considerably, and proved on examination to be larvæ of the *Clostera reclusa.* Only one of these was observable on receipt, for the others were spinning, or had spun, the Osier leaves together as shelters temporarily, or for pupation. In one instance, the head of the little caterpillar was observable moving from side to side almost as fast as it could stir in forming its web and leaf shelter.

A few days later, Miss Sturge forwarded some Osier shoots for examination. On these the leaves were in some instances almost eaten away by the caterpillars, so that only about a quarter, or less than that, of the lowest part of the leaf might be still remaining. In other cases the side of the leaf was so eaten away as to leave only the mid-rib, with remains of leaf at distances. So far as appeared by the specimens sent, the damage was chiefly to the leafage towards the end of the shoot, and the terminal leaves were especially chosen for spinning together.

In her letter accompanying the specimens, Miss Sturge expressed fear lest her Osiers should be destroyed by the attack, and enquired whether, if she was to cut off the tops of the Osiers with the grubs in, this would save the lower part, and I replied that if at any reasonable cost the little bunches of spun-up leaves with the contained caterpillars could be nipped off and *destroyed*, that this might certainly be expected to make a deal of difference in danger of recurrence of attack.

The caterpillars, until they were changing colour for the chrysalis stage, corresponded fairly well with the description given in Newman's 'British Moths,' p. 228, as having a broad grey stripe down the middle of the back, this stripe being varied with yellow markings,* and also having a central velvety spot on the fifth, and another on the twelfth, segment. On each side of the grey stripe is a broad smoke-coloured stripe running along each side and the under part of the caterpillar; legs and sucker-feet are also smoke-coloured; but between these and the side smoky stripe is a broad line, or narrow stripe, of black and yellow spots. The head is black or dark; the body hairy.

The first few specimens which I had at the end of June being just about full growth, I had little opportunity of watching them through their changes from the characteristic colouring; but later on, beginning about the 11th of September, I was able to observe the gradual change of the autumn brood from the commencement of alteration of tint up to pupation.

The caterpillars were then about an inch in length, and the change began by the stripe along the back becoming of a more uniform tint,

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* My specimens were more marked along the back with black spots, or small lines, see figure, p. 141, copied from figure 1, plate xxxvii, of 'Larvæ of British Butterflies and Moths,' by W. Buckler, Vol. III. Ray Society.

the grey becoming yellower, and the black markings, intermixed with the paler tints, fainter. In a day or two, the side stripe beneath the black stripe became orange colour, and (above) the segments in front of the most forward black spot on the back became orange yellowish, those behind it with orange yellow bands across, so as to give a general yellowish appearance to the back. On the 15th, the only larva remaining unspun-up had further changed to the stripe above being reddish brown, with orange or yellow marks, the side stripes orange and reddish brown, and the colour beneath of the same shade of brown as the ground of the long back stripe.

At this date all the larvæ I had were either on the point of spinning, or had spun leaves together for pupation. The open space between the leaves being filled with web, or rather a kind of gummy film, with some thicker threads dispersed irregularly on the surface.

On examining the spun-up leaves at date of writing (January 12th, 1894), I found the pupa of a rather dark red brown colour, with much darker wing-cases and head end, lying within the web. The first brood is stated (see Newman's 'British Moths') to be full-fed about the 5th of July; the second at the end of September; "then spinning a web amongst the leaves of its food-plant, and turning to a chrysalis in the retreat thus fabricated, it remains in that state throughout the winter."

The moth appears in May and August, and is popularly known as the "Small Chocolate-tip"; scientifically the name is *Clostera pigra* (Hufn.), or *C. reclusa* (Fb.). The latter name is given in South's list, p. 5, only as a synonym. The shape and markings of the moth are given at figure, p. 141. The colour of the fore wings is purple grey, browner grey, and darker towards the hind margin, with various markings and transverse pale lines; the hind wings dark brown-grey.

The eggs were given by Dr. Ernst Hofmann as flat, hemispherical, and of a red flesh colour. The food of the caterpillars is given by various writers, respectively, as the Dwarf Sallows, *Salix capræa*, and *S. cinerea;* as Willows and Aspen; and also by Dr. Kaltenbach, as found by himself in late summer, as on low growths of the *Abele*, or White Poplar, and the Grey Poplar, *i. e.*, *Populus alba* and *P. canescens;* and I have myself found that, when other food was not accessible, specimens in confinement would feed on leaves of Weeping Willow.

The species is considered to be widely distributed, both in England and Ireland, and it is also a Continental kind.

PREVENTION AND REMEDIES.—For prevention of recurrence of attack, it cannot fail to be of use, when the first brood of caterpillars are spinning up their leaf shelters in which to turn to chrysalids about the beginning of July, to have these little bunches of leaves picked off and destroyed. To do it effectively, some one interested in the success of prevention would do well to examine about the middle of July, and see whether the caterpillars had gone through the change to the chrysalis condition. It is important to be sure of this, for at first, if disturbed, the caterpillars would be very likely to come out of their shelters, and little good might be done by the gathering of their spun-up leaves. But as soon as the change has taken place the bunches may be collected and burnt. This would greatly lessen the amount of the moths to be expected in August to start the second attack, and in case of this occurring, any leaf-nests should be again picked off that are observable on the Osiers about the end of September, or later; or if it is found they have fallen at the time of fall of the leaf, any measures that are available should certainly be taken to get rid of these.

What is really practicable for the purpose, probably only practical Willow growers can say. Any chemical dressing, such as lime or gas-lime, in quantity to injure the chrysalids might hurt the Willow roots, or the chemical effect might alter the pliancy of the shoots. If the state of the ground allowed the surface rubbish to be scraped together and burnt before the ground was cultivated in whatever method is requisite, this would get rid of a great many; and it would be well also to search on the Willow stools, at the bottom of the cut-back shoots, for what may have lodged there.

With regard to *remedy* when the caterpillars are ravaging on the shoots, the matter is very difficult. Miss Sturge, in her letters to myself, mentioned, in reference to hand-picking, that the attack was really terrible, so that hand-picking only cleared some amount of the many thousands.

Probably the only effective way to treat them would be to spray with Paris-green, from a Knapsack Sprayer, which could be carried on a man's back, and worked by him by means of a hose.* Where there are objections to the use of Paris-green, it would be worth while to try washes of a mixture of soft-soap and mineral oil, which could be prepared at home or purchased. The mixture sold under the trade name of "Anti-pest," by Messrs. Morris, Little & Son, Doncaster (see *ante*, p. 37), would save much trouble in mixing.

Water alone, if cold, sometimes does good in clearing caterpillars in hot weather, and this would also be beneficial in clearing the Cuckoo-spits mentioned at p. 141. These insects are so generally known that they do not seem to require a special notice. Most of us know them in their fully developed state as little greyish or brownish insects, with lighter markings on the upper wings, which are deflexed, a quarter of an inch in length, or thereabouts, and with the power of taking tremendous leaps. From this habit, and their somewhat frog-like shape (in miniature) they gain their common name of "Froghoppers." The not pleasing name of "Spittle Insects" is given from their habit of living in their early stages in a little mass of frothy-like moisture, an excrementitious shelter for themselves, supplied by the great quantity of fluid which they draw from the shoots (sometimes exceedingly to the injury of the growth) with their suckers. In their early stages they are of the same shape as when they become perfect "Froghoppers," but without wings, and also of a pale whitish or greenish colour. Scientifically they are Cercopidæ; specifically the *Aphrophora spumaria*, Germ., the *Cercopis spumaria*, L. They are especially injurious to Willows. In garden treatment, I have found heartily applied drenchings of water very useful for getting rid of them.

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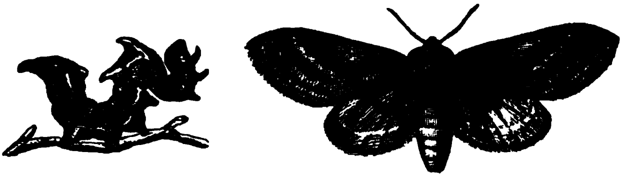
* All requisite details are given in my pamphlet on 'Paris-green,' procurable, price 2d., from my publishers, Messrs. Simpkin & Co., Stationer's Hall Court, London, E.C.; or I would have pleasure in giving it myself to any applicant.

"Pebble Prominent" Moth. *Notodonta ziczac*, L.



NOTODONTA ZICZAC.—Moth and caterpillar, life size.

In the course of the communications sent me by Miss Sturge, from the Connemara Basket Industry, Letterfrack, Co. Galway, I found, early in September, that, in addition to the moth infestation mentioned in the preceding pages, and various other Willow pests that were doing damage, the curiously shaped caterpillar of the *Notodonta ziczac* moth (figured above), so-called from the peculiar zigzag position which it sometimes assumes, was also present.

The slight descriptions which are commonly given of the colours of the larva are very little help, and I had no opportunity of observation until the larva was an inch and a half long, therefore I give a few notes, more particularly of the early stages, from the observations of the late Rev. John Hellins, published in 'Larvæ of British Butterflies and Moths,' by the late W. Buckler, Vol. II., pp. 152, 153 (Ray Society).

The egg is stated there to be what is called button-shaped, flat below; one twenty-fifth of an inch across; shell finely granulated; colour greenish white, afterwards white. Larva at first with a large black head, yellow body, and small hump on twelfth segment, otherwise smooth. After the first moult, the two sharp humps on the back also appear, accompanied by variety of marking, as a whitish grey colour along the back, with darker stripe, dark streaks on the side, and the belly dusky, &c. At the third moult several caterpillars under observation were found to show a pink tinge.

Of the subsequent change, Mr. Hellins mentions:—"The full-grown larva is generally handsome, but varies a good deal in colouring; I have short notes of one which was lilac above, dark brown below, the hump on twelve, orange red with yellow streaks, a yellowish line along the spiracles." Another variety very fully described had "the colour mostly a mixture of pale delicate grey and pink," varied with orange patches, pale yellowish streaks, &c.; and a third variety was paler still.

In my own specimen from Connemara, which appeared to be fully grown, the colouring most resembled the first of Mr. Hellins' three varieties, mentioned above, in the general colour, which was pinkish or purplish, but brown or lurid below. The dorsal humps, or bluntly pointed tubercles, were brown before, edged with a pale line, and a dark stripe ran along the back, from the brownish head to the humps, paler on the segment next these tubercles.

The segments beyond the fourth sucker-foot were mottled with bright rusty and yellow colours, disposed in two short broad curved bands pointing upwards, the upper slant of the caudal segment pinkish; a white line down outside of fourth proleg, faint white transverse lines on sides, and two faint white lines along back, from second dorsal hump to the hump near the caudal extremity. Altogether this full-grown larva was certainly, as Mr. Hellins remarks of some of his specimens, a very handsome creature.

The autumn brood of caterpillars are stated by Edw. Newman to "spin their slight cocoons on the surface of the earth, and to remain in the chrysalis state all winter."

The moth is double-brooded; but as from comparison of observations of different writers, British and Continental, it appears that the moth may be found from April to July, and the caterpillars from June to September, it appears as if for all practical purposes, the presence of the infestation might be considered as pretty constant during the warm season.

The moth is of the shape and pattern figured at heading, with a tooth at the hinder margin of the fore wings, which are chiefly ochreous brown, with a large pale grey blotch occupying about a third of the middle part of the fore edge, and various markings forming an eye-like spot at the tip of the wing; the hinder wings have a dingy brown ground colour.

Amongst the various kinds of injury to leafage sent me, or described to me, by Miss Sturge as going on amongst her Osiers to a very serious extent, I cannot tell how much might be owing to this special kind, the "zigzag" caterpillar. I should think, however, that part of the great mischief reported to me on June 13th, might very likely indeed be caused by the larvæ of this *Notodonta ziczac* whilst still in the very young state which they would almost certainly be in early in this month.

Some of this mischief was caused beyond doubt by caterpillars of the *C. reclusa* moth, and the "Cuckoo-spit" insects, as mentioned in the preceding paper; but on turning to my reply to Miss Sturge's letter, I find I mentioned, "From the manner in which the skin of the leaf has been gnawed, I should think that very likely you had the 'Willow Beetle' present." In the case of this beetle infestation the larvæ feed on the under side of the leafage, working right through to the upper films until it is so thin that it cracks, or may crack, and dry away. Although I was in communication with Miss Sturge until autumn or early winter, no observation was made of Willow Beetle being seen; but finding later on that *N. ziczac* was present, I turned to the account of it by Mr. Hellins (previously quoted), and there I find the following passage:—"After the larva begins to feed, a greenish tinge comes over the body; at first the larva gnawed only one side of a Willow leaf, leaving the opposite skin and all the ribs untouched."

With advance of growth, presumably, this habit is left off; so far as I saw, the leaves of Weeping Willow, which I used as food, were consumed from the edge. But in future instances of infestation it would be well worth while to investigate this matter fully.

The methods of prevention and remedy would be similar to those for destroying the *C. reclusa*, noticed at pp. 143—145.

SAWFLIES.—Willow Sawfly. *Nematus salicis*, L.

Amongst the various kinds of Willow infestations of which samples were sent, were those of several species of Sawflies, of which the following is, I believe, not very common, and possibly the local outbreak to such a serious extent may have been influenced by the peculiar weather conditions of the spring and early summer.

On July 6th, I was favoured with the following note of observation from Mr. J. Brooke, of Haughton Hall, Shifnal, Salop:—"The caterpillars, of which I enclose a specimen, I found in such numbers on a row of Pollard Willows, at Sutton Maddock in this county (Salop), as to completely strip them of leaves. I presume it is the larva of some Sawfly, but I am not able to identify it, nor did I ever see it in such quantities before."

The specimen sent agreed even to almost (if not quite) the minutest particulars with the description of the larva of the *Nematus salicis* given by Mr. Cameron, and the coloured figure after Brischke.* The peculiar colouring of the caterpillar makes it very noticeable; the head being black; the first three segments, and also the last of some tint of orange, and the intermediate segments bluish green. Along the body are seven rows of black points or spots, which are sometimes counted as nine where the two black spots on each segment, between the dorsal and first side row, are also counted as forming a row on each side. The spots, or points, are fewer on the orange segments, and over the tail is a large black spot. "The thoracic legs are marked with black, the claws being of the same colour." It may perhaps be of some service to remark in passing that "Sawfly" caterpillars are commonly distinguishable from caterpillars of butterflies and moths by the much greater number of their prolegs, or sucker-feet, so that altogether, counting claw-feet and sucker-feet, there are commonly from eighteen to twenty-two legs. In the genus *Nematus* the larvæ have twenty or eighteen legs; in the case of the *N. salicis* I am not perfectly sure of which number it is possessed, but I think it is twenty.

Where the larvæ are numerous, as occurs on the Continent, they are described by Kaltenbach as feeding voraciously on the leafage of various kinds of Willows; and it is mentioned by Dr. Ritzema Bos that there are two to three broods in the year. The cocoon is formed in the ground, so that where attack has been troublesome, lightly disturbing the surface of the soil so as to skim off the top down to where the cocoons lie and destroying them in the infested earth, would much lessen coming attack.

As this *N. salicis* does not appear to be very common in this country, it has seemed worth while just to allude to its presence; but so far as I am aware it was only seriously destructive in the one locality named.

Other kinds of Sawfly attack were also present on Willow, of which specimens were forwarded to me, but which I have not entered on at length, as they were not of special importance. In practical work these infestations are generally observed in larval state, or are drawn attention to by the peculiar method of injury, or by the growths sometimes caused, as for instance, the green or rosy galls sometimes found in great numbers on Willow leaves.

The special kind of Sawfly causing each kind of attack is often not noticeable without much watching; amongst other reasons, because when the grubs are large enough, or the galls large enough, to be noticeable, the Sawflies which laid the eggs may very likely have passed away. But I add a figure of the Gooseberry Sawfly, *Nematus ribesii,* magnified, belonging to the same sub-group as *N. salicis*, as an example of the general appearance of the imagos of this genus. The imago of the *N. salicis* is to some degree distinguishable by its large inflated yellow abdomen, and the nerves, blotch, and line below it (*stigma* and *costa*) on the front edge of fore wings being black; the wings are hyaline and yellowish; length of body half an inch or rather less. For full description see Mr. P. Cameron's work cited p. 148.

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* See 'Mon. of Brit. Phytophagous Hymenoptera,' by P. Cameron (Ray Society), Vol. II., pp. 163, 164; and Plate VII., fig. 9, in Vol. I.

NEMATUS RIBESII, magnified; length of body from a quarter to a third of an inch.

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REPORT OF OBSERVATIONS
OF
INJURIOUS INSECTS
AND
COMMON FARM PESTS,
DURING THE YEAR 1895,
WITH METHODS OF
PREVENTION AND REMEDY.

NINETEENTH REPORT.

BY
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54, HATTON GARDEN, E.C.

PREFACE.

THE observations of the past year have given us an unusually good opportunity of remarking how far amount of presence of injurious insects may be affected (or not affected at all) by exceptionally low temperatures, such as those from which we suffered in January and February of 1895. From records of extreme lowness of temperature taken from instruments in the regular Stevenson's screens,* we find the extraordinarily low minima that were registered at various stations from Aberdeen to Kent, thus ranging at distances from the North of Scotland to the South of England. These show readings *below zero* as follows: −17° at Braemar, Aberdeen; −13° Esthwaite, Lancashire; −8° Ketton, Rutland; −5° Loughborough; and −8° Bromley, Kent. That is to say, in the popular manner of expressing amount of cold, temperatures in order given above respectively of forty-nine, forty-five, forty, thirty-seven, and forty "degrees of frost"—*i.e.* degrees below freezing-point, which is 32° Fahrenheit.

At Loughborough the "mean" of the temperatures of the ten days from the 5th to the 14th of February inclusive was only 16·5°—that is, within a few fractions, sixteen "degrees of frost." These notes refer to the *air temperatures*, of which full records are given in our meteorological publications, and also with additions of local circumstances exceedingly serviceable for comparison with subsequent local insect conditions, and in the 'Times' daily meteorological reports published during the continuance of the unusual cold.

But beyond this, and in regard to the still more important point as to effects on insect life of the amount of cold *to which they are exposed in the ground wherein they lie*, I take leave to quote Mr. Symons's words: "Another striking proof of the severity of the 1895 frost is afforded by the temperature of the earth" ('Monthly Meteorological Magazine' for March, 1895).

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* See Symons's 'Monthly Meteorological Magazine' for March, 1895. London: Edward Stanford.

For twelve consecutive days—that is, from February 12th to February 23rd inclusive—the thermometer with its bulb one foot below the surface of the earth (at Mr. Symons's own station at Camden Square, London, N.W.), at the 9 a.m. readings, only marked 31°, or 31° and one or more fractions, this showing (again to quote Mr. Symons) "twelve consecutive days, every one of which was cold beyond precedent since the observations" [at Camden Square] "began in 1871."

Of the widespread presence of low earth temperatures none will need to be reminded who (in towns) were inconvenienced by the deficiency of water supplies from breaking of the supply-pipes, or (in farm work) by the long-continued impossibility of getting the plough into the frost-bound ground. For record of this we have only to refer back to the weather notices in our leading agricultural journals; but, taking just two or three by way of examples, we find in the 'Dublin Farmer's Gazette' of March 2nd, 1895:—"The wintry weather that set in at the end of December continued with more or less severity to almost the end of February. There was a frost every night till that of the 27th—28th; but now . . . March has begun with a decided rise in the temperatures. The thaw seems also to be general in Great Britain; but the effects of the prolonged frost will be felt for some time to come." In the 'Agricultural Gazette' for March 4th (1895) the report of February 28th from Nottingham is as follows:—"To use the language of the day, the month of February, 1895, has been a 'record' in the shape of Arctic severity. To have the thermometer from two to ten degrees below zero five or six nights in succession is not within the memory, I suppose, of the oldest inhabitant." From West Herts (same date) it was noted:—"The frost is slowly going out of the ground. . . . Yesterday was the first day we have been able to plough since the long frost commenced."

For technical *meteorological* study, every detail will be found in the weather reports; but for the subject under consideration, the *agricultural* reports of the widespread impossibility of ploughing consequently on the frost-bound state of the ground give a better basis to stand on, as to action of cold on the insect presences frozen hard up in it, than anything else we could have.

So far as I can judge from reports sent to myself during 1895, I should certainly say that in no case was there evidence to show that presence of insect infestation was lessened by the severe cold of the early part of the year. The *appearance* of *some* of the crop or fruit infestations was retarded until they were thawed into active life in their lurking-places, or the surface of the ground was sufficiently softened to allow them freedom; but beyond this I did not find any *direct* effect on insect presence from the cold. *Indirect* effect there certainly was, but this tending *to increase* the amount of insects, or of their injury, from various causes; as, for instance, sowing of spring corn being retarded, and the young plant consequently not having time to get ahead before the season of attack of its maggot pests; or, again, as in Forfarshire, where the severe weather and accompanying gales are even now bearing fruit in the quantities of Pine Beetles (*Hylurgus piniperda*) to which the broken and fallen Pine-boughs and timber afforded nurseries.

Looking at the insect attacks of last year in coincidence with the above-mentioned severe cold, we find that though there was not any widespread devastating attack of any one kind of insect all over the country, yet there were seriously injurious outbreaks of various kinds which winter in such methods as to expose them thoroughly to weather action, and thus show that cold cannot be looked to for protection.

The eggs of the Winter Moth (of which the caterpillars were one of the very bad attacks last year) are laid for the most part in the early winter on buds, twigs, &c., of orchard and other trees, where they are exposed to *all* weather, snow, thaw, frost, sunshine, and wind sweeping by to intensify the cold. The "Pine-shoot" Moth caterpillars (see p. 73) were obviously none the worse for their winter residence in their shelters at the end of the shoots. On *the surface* of the ground, the bad attack sent me at the beginning of April of the Cabbage Root-gall Weevil showed that these were uninjured by the then recently preceding cold. The unusually bad attacks of Gooseberry Sawfly caterpillar in the summer showed that the preceding generation had passed the winter very successfully in their cocoons *just below* the surface.

Crane Flies, or Daddy Longlegs grubs, may be found more or less from December onwards, and, weather permitting, sometimes are exceedingly mischievous at corn-roots in February; and the great damage to grass-roots at Langholm, Dumfries-shire (see p. 33), in the past season may be taken as a proof that these grubs are not cleared out by ground cold.

Almost all the common crop insect attacks were present, and amongst those deserving especial attention is that of the so-called "Ground Beetles" to Strawberries, which it was an especial pleasure to myself to work up thoroughly, both for practical use, and as showing the imprudence of attributing error to careful observers simply because it may chance the infestation is not known generally.

The great point, however, of the observations of last year has been the attacks of *Diptera* (two-winged flies) to cattle, horses, and other animals. These began with the Forest Fly enquiry set on foot early in the year, and extended thence to enquiries regarding other species of Hippoboscidæ, and thence to Gad and Breeze Flies, and also to Warble or Bot Flies, including amongst these the *Hypoderma lineata*, which represents our common Ox Bot Fly, the *H. bovis*, in the United States of America, and is present in this country, though whether injurious (in addition to our common kind) to any extent worth consideration, I have not yet had opportunity of ascertaining. Some information as to warble as an infestation of deer has also been kindly contributed, and, from the good supply of maggots sent, I have been enabled to identify the kind (as was to be expected) as the *Hypoderma diana*.

Altogether the year has been one of interesting observation regarding crop and animal insect pests, regarding which, space permitting, I should have been glad to give fuller details. The following list gives the names of most of the kinds of British insects of which I have had specimens or enquiries:—

Beetles (*Coleoptera*).

Bean-seed Weevil, *Bruchus rufimanus*	Stored Bean-seed.
Beet Carrion Beetle, *Silpha opaca*	Young Mangolds.
Cabbage Root-gall Weevil, *Ceutorhynchus sulcicollis*	Cabbage- & Turnip-roots.
Chafer, Cockchafer, *Melolontha vulgaris*	Leafage and Grass-roots.
" Summer, *Rhizotrogus solstitialis*	" "
" Rose, *Phyllopertha horticola*	" "
" Golden, *Cetonia aurata*	Flowers.
Corn Beetle, *Cucujus testaceus*	Stored Corn.
Elm-bark Beetle, *Scolytus destructor*	Bark.
" " *multistriatus*	"
Granary Weevil, *Calandra (Sitophilus) granaria*	Stored Corn.
" " " *oryzæ*	"
Ground Beetle, *Pterostichus madidus*	Strawberry fruit.
" " *vulgaris*	"
" *Harpalus ruficornis*	"
Mangold Beetle (Pigmy), *Atomaria linearis*	Young Mangold-roots.
Mealworm Beetle, *Tenebrio molitor*	Meal and Flour.
Pea- and Bean-leaf Weevils, *Sitones* of different species	Leafage.
Pea-seed Weevil, *Bruchus pisi*	Stored Pea-seed.

Pine Beetle, *Hylurgus piniperda*	Pine-bark and shoots.
Plum Beetle, *Scolytus rugulosus*	Plum-branches.
"Timberman" Beetle, *Astynomus ædilis*	Pine-bark and wood.
Turnip-flower Beetle, *Meligethes æneus*	Blossoms and buds.
Turnip Mud-beetle, *Helophorus rugosus*	Turnip-bulbs and leafage.
Turnip-seed Weevil, *Ceutorhynchus assimilis*	Turnip-seed.
Weevil, Clay-coloured, *Otiorhynchus picipes*	Hop.
Wireworms (larvæ of various *Elaters*)	Roots of grass and crops.

Butterflies and Moths (*Lepidoptera*).

Antler Moth, *Charæas graminis*	Grass-roots.
Buff Tip Moth, *Pygæra bucephala*	Beech, &c.
Death's Head Moth, *Acherontia atropos*	Potato-leafage.
Eyed Hawk Moth, *Smerinthus ocellatus*	Apple-leafage.
Goat Moth, *Cossus ligniperda*	In trees.
Granary Moth, *Tinea granella*	Stored Grain.
Mediterranean Mill Moth, *Ephestia kuniella*	Wheat-flour.
Mottled Umber Moth, *Hybernia defoliaria*	Buds and leafage.
Pine-shoot Tortrix Moth, *Retinia defoliaria*	Pine-shoots.
Puss Moth, *Dicranura vinula*	Poplar-leaves.
"Red Bud" Caterpillar, *Lampronia rubiella*	Raspberry-stems and buds.
Turnip Moth, *Agrotis segetum*	Turnip and other roots.
Winter Moth, *Cheimatobia brumata*	Buds and leafage.

Two-winged Flies (*Diptera*).

Cabbage- and Turnip-root Maggots, *Anthomyia* of various species.	Roots.
Celery-leaf Miner, *Tephritis onopordinis*	Leaves.
Crane Fly or Daddy Longlegs, *Tipula oleracea*	Grass-roots.
,, Spotted, *Tipula maculosa*	,,
Forest Fly, *Hippobosca equina*	Horses, Cattle, &c.
Frit Fly, *Oscinis frit*	Oats.
Gad or Breeze Flies:—	
Great Gad Fly, *Tabanus bovinus*	Cattle and Horses.
Blinding Breeze Fly, *Chrysops cæcutiens*	,,
Horse Breeze Fly, *Hæmatopota pluvialis* *	,,
Gout Fly, *Chlorops tæniopus*	Barley.
Hessian Fly, *Cecidomyia destructor*	Wheat- and Barley-stems.
Mangold-leaf Maggot, *Anthomyia betæ*	Mangold-leaves.
Pear Gnat Midge, *Cecidomyia* (*Diplosis*) *pyrivora*	Young Pears.
Sheep "Tick" or Spider Fly, *Melophagus ovinus*	Sheeps' fleeces.
Warble Fly, *Hypoderma bovis*	Cattle hides.
Warble Fly (Deer), *Hypoderma diana*	Red Deer.

Sawflies, Gallflies, &c. (*Hymenoptera*).

Apple Sawfly, *Hoplocampa testudinea*	Young Apples.
Gooseberry Sawfly, *Nematus ribesii*	Gooseberry- and Currant-leaves.
Pine Sawfly, *Lophyrus pini*	Pine-leaves.
Oak Spangle Gall, *Neuroterus lenticularis*	Beneath leaves.
Oak Woolly Gall, *Andricus ramuli*	Woolly growth on male catkins.
Pear Slugworm, *Tenthredo cerasi*	Leafage.
Sirex, *Sirex gigas*	Fir timber.
,, Steel-blue, *Sirex juvencus*	,,

Aphides, Scale Insects, &c. (*Homoptera*).

American Blight Aphis, *Schizoneura lanigera*	Apple-bark.
Beech Aphis, *Phyllaphis fagi*	Beech-leaves.
Corn Aphis, *Aphis granaria*	Corn-ears.
"Colliers," *Aphis rumicis*	Mangold-leaves.
Woolly Currant Scale, *Pulvinaria ribesiæ*	Currant-stems.

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* Other species of Gad Flies sent, enumerated at p. 128.

Besides the above there were various insect attacks of little agricultural interest, though affecting various trades or industries, and several only too important, as of Mites, or "Red Spider," namely, the Gooseberry Red Spiders, the *Bryobia prætiosa*, and also the *Bryobia ribis* (n. sp.), also the Black Currant Gall Mite, the *Phytoptus ribis*, which continues to spread, and the Hay Mite and Cheese Mite, respectively the *Tyroglyphus longior* and *T. siro*. Millepedes of various kinds, especially the Spotted Millepede, were, as usual, destructive; and altogether the year was marked by much presence of crop infestation; and also, as in previous years, there has been enquiry regarding colonial insect attack, especially to Sugar Canes.

I have to express my thanks for much kind assistance from colleagues, and for the many liberal presents of valuable entomological serials, by which I am greatly assisted in my work.

But amongst the entomological events of the past year, it is only a due respect to allude to the loss which all interested in the preservation of their crops or fruit have suffered in the decease of Dr. C. V. Riley, late Entomologist of the Department of Agriculture of the United States of America, consequently on being thrown from his bicycle. Dr. Riley was a countryman of our own, and, on his settlement in the United States of America, passed some years on a farm, thus laying a foundation of practical knowledge for the vast and sound scientific acquirement which claims for him the place of the greatest economic entomologist the world ever saw. For many years he has used his talents unceasingly in gaining, and also in freely imparting, information which has been of the utmost service in counteracting not only the great infestations of the Continent of America, but for which he was the special world-wide referee. In many points we benefited much by his assistance in this country; and to myself, as to all his friends, his death is the loss of a kind and skilled helper.

In home assistance in the past year, in addition to that which I have acknowledged accompanying the notes of the different infestations in regard to which I have met with much valuable aid, I desire to acknowledge very especially the cordial and courteous support always accorded both to my work and myself by our agricultural, and also by much of our general Press. I thank them most heartily.

For the use of the illustrations at pp. 4, 15, 23, 26, 37, and 57, I am indebted to the courtesy of Messrs. Blackie & Son, Glasgow; figures at pp. 18 and 62 are from Newman's 'British Moths'; those of Breeze Flies at pp. 128, 130, by kind permission of Messrs. Baillière & Co., are from Neumann's 'Animal Parasites,' translated by Dr. Fleming; the remainder, excepting where otherwise mentioned, have been prepared for this series of Reports, and are mainly from the pencil of Mr. Horace Knight, of the staff of Messrs. West, Newman & Co., 54, Hatton Garden; and amongst these I think the two plates giving figures of the complicated structure of the foot of the Forest Fly will be found of much interest.

In the coming season I hope to continue attention to all enquiries regarding insect infestations with which I may be favoured, to the very best of my power; and, further, I should like to add that, amongst work in progress, I trust that the Exhibit of Economic Entomology which, by the courteous request of the Council of the Bath and West and Southern Counties Society, I am preparing for their meeting at St. Albans in May next (accompanied by a series of coloured diagrams, from the pencil of my sister, of subjects specially selected) may be found practically useful.

ELEANOR A. ORMEROD, F.E.S.

TORRINGTON HOUSE, ST. ALBANS,
February, 1896.

List of Attacks of Injurious Insects, &c., noticed in this Report.

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* These two species were sent from Indian localities, but are noted, as being similar to our own kind in habits and remedial measures.

NOTES OF OBSERVATIONS

OF

INJURIOUS INSECTS

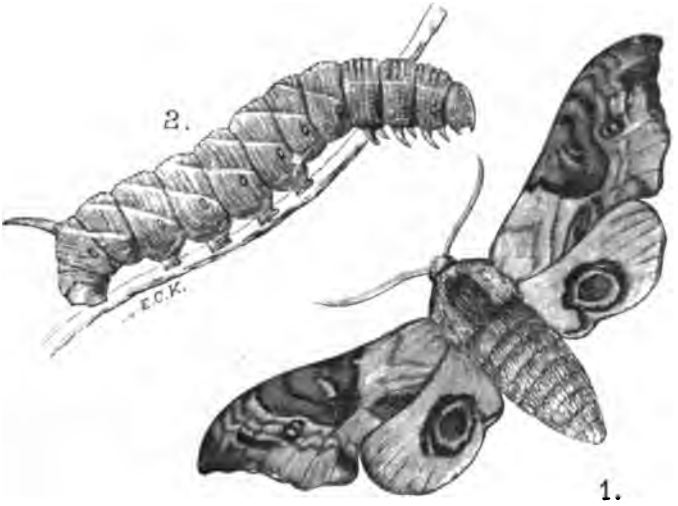
AND

COMMON CROP PESTS

DURING 1895.

APPLE.

Eyed Hawk Moth. *Smerinthus ocellatus*, L.



SMERINTHUS OCELLATUS.—1, Eyed Hawk Moth; 2, caterpillar.

THE great green caterpillars of the Eyed Hawk Moth, which I noticed in my preceding Report, appear to call for a few additional observations as being more of an orchard pest than has been generally supposed. In 1894 I heard of them from Bewdley, in Worcestershire, and from Meldreth, Cambridgeshire; and in the past season they have been mentioned as to some degree troublesome from two localities in

Kent. The observations previously given appear to have directed attention to the great mischief which the caterpillars *can* cause when present, but of which the reason is often overlooked, notwithstanding their great size, from their colour so much resembling that of the Apple-leaves.

The damage, it will be seen on reference, is generally noticed as being to the young trees, and also (where it occurs at all) as completely sweeping off the attacked leafage. In one of the 1894 notices it is mentioned:—"The caterpillar is very destructive; from its colour it is scarcely discernible, and attention is only drawn to it by seeing the young shoot, which it seems to prefer, entirely stripped of its leaves." —(T. H.) Another observation of the same date noted regarding the caterpillars:—"I have found seven or eight each on a separate tree (Apple-trees planted one or two years). They entirely denude the tree of all its leaves."—(A. H.) *

On the 25th of Feb., 1895, Mr. Sydney Lee wrote me from Crocken Hill, Swanley Junction, Kent:—"*Re* the Eyed Hawk Moth.—They are not very common in this district, as when I showed a number to some fruit-growers here, they looked on them more as curiosities. I have found quite a number during the last two seasons,—should think I found almost fifty during the last. I found them only on young Apple-trees. Although so large, we do not look on them as particularly troublesome because of their comparative scarcity."

On the 28th of August I received a good specimen of the caterpillar from Mr. Charles Ramsey, of the Fruit Nurseries, Crawley, Kent, with enquiries as to its name and history, and mention that it was "not a very troublesome pest at present, being only found on Apple-trees here and there about the nursery"; but that it eats all the leaves of the young trees, then drops to the ground, and burrows out of sight.

The caterpillar, when full-grown, is about the size figured, but it has been recorded as quite three inches in length; the colour of a yellowish or bluish-green, or of the colour known as "apple-green"; the skin rough, and dotted with white, and having on each side seven white stripes slanting backwards at the top; the seventh stripe longer than the others, and continued up the horn-like process at the tail. This horn varies in colour: early in life it is pink; when the grub is nearly full-grown it is pale or sky-blue in colour, and greenish or black at the tip, and the side stripes, at least when the grub is nearly full-grown, have a line of darkish green along the front edge. The head (after the first moult) is triangular at the top; the claw-feet pinkish-brown, the sucker-feet green. The grub varies very much in colouring during its growth.†

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* See page 2 of 'Eighteenth Report on Injurious Insects,' by Ed.

† For full details see 'Larvæ of British Butterflies and Moths' (Ray Society), by Wm. Buckler, vol. ii. pp. 99—103.

When full-fed (as noted above by Mr. Ramsey) the caterpillar goes down into the ground. There it turns, in a little chamber about two inches below the surface, to a red-brown chrysalis, from which the moth comes out in the following summer. Thus, to quote the summary of life-history given by the Rev. John Hellins in page 100 of work cited before, "we have the moth in May, June, and July; the larva stage lasting some six weeks in June, July, August, or September; and the pupa stage extending through autumn, winter, and spring." The earliest day of egg-laying which I find noticed is June 11th.

The moth is a beautiful insect, of the shape and markings figured at page 1, but not usually quite so large. The fore wings are rosy-brown or ash colour, with olive-brown markings; the hinder wings rosy, shading to brown or grey at the margin, with the large eye-like spot, from which the name of "Eyed" Hawk Moth is given, in the centre of each wing. These spots are grey in the centre, with a blue ring outside, and this again surrounded by a black border.

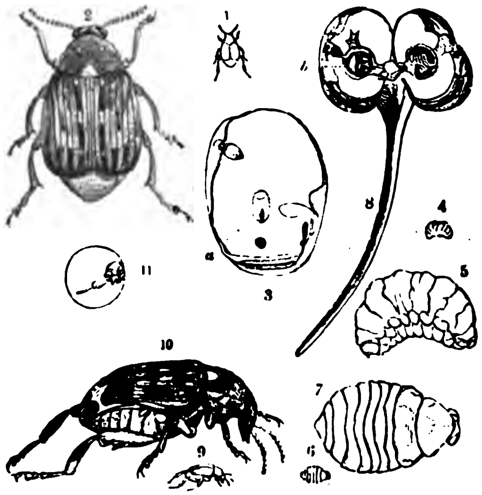
In regard to methods of prevention and remedy, one good plan, where the caterpillars have been observed on the Apple-trees, would be to skim off the surface soil, taking care not to go deep enough to hurt such Apple-roots as may be near the surface. The large red-brown chrysalids would be easily seen, and might be destroyed, or any boys about the garden might be allowed to earn a few pence by selling them (as they are not very commonly met with) to any neighbouring "naturalist."

Generally the infestation does not seem to be noticed (at least practically) until it fairly forces itself on attention by the leafage of the attacked boughs being stripped; but where the caterpillars are known to have been present in the previous season it would be well to keep watch, and clear them before they are getting to their full growth towards the latter part of August or beginning of September. By jarring the boughs so as to make the caterpillars fall, or by hand-picking from the young trees which appear to be the most attacked, this might easily be done.

It is objected to me by some of our entomologists that it is a pity to destroy these handsome and somewhat scarce insects, but it appears to me that where we have the opportunity, it is much the most desirable way with great insects that have an obvious power of wasting our crops to get rid of them as completely as we can.

BEAN.

The European Bruchus or Bean-seed Beetle. *Bruchus rufimanus*, Boheman and Schön.; = *B. granarius*, Curtis. **American and South African Bean-seed Beetle.** *Bruchus fabæ*, Riley; = *B. obsoletus*, Say, also *B. obtectus*, Say.



1 and 2, *Bruchus rufimanus*, nat. size and mag.; 3, infested Bean split open; 4 and 5, larvæ, nat. size and mag.; 6 and 7, pupæ, nat. size and mag.; 8, Bean injured by beetle, vegetating; 9 and 10, *B. pisi* (Pea-seed Beetle), nat. size and mag.; 11, injured Pea.

The attack of the Broad Bean-seed Weevil, scientifically distinguishable as the *Bruchus rufimanus* (sometimes, formerly, as the *B. granarius*), is always more or less present here, and has been one of our regular pests, as shown by the late Prof. Westwood, for some time before the year 1839; but as in some observations published in September last the compiler was obviously not aware of the distinctions between this our common English kind and the still more injurious kind *Bruchus fabæ*, which has of late years been under notice of the Board of Agriculture of the United States of America, it may save the repetition of somewhat grave error, and save also unnecessary anxiety, to offer some observations on both species.

So far as may be learnt from reports, or our standard catalogues of British beetles, or standard entomological works, I believe the *Bruchus fabæ* has *never* yet been known here; but it may come, and as I have had the opportunity of minute study of the insect, and its extraordinary power of doing injury, in specimens sent me from our own colonists in

South Africa (where, as well as in the United States, it is to be found), I add to the following observations on our own special Bean-seed pest some notes regarding the more destructive kind brought up to date of writing these lines.

"*Bruchus rufimanus* is the common Bean Weevil of England. . . . It is both a common and destructive insect." * The species is considered to range throughout central and southern Europe, Syria, Egypt, and all of northern Africa, and also occurs at Monte Video, South America. The above-named wide distribution accounts for the great extent to which it occurs in imported Broad Beans, a subject on which especial enquiries were sent me during the past season.

The beetles are rather less than the sixth of an inch in length, and of the shape figured at 1 and 2 (nat. size and magnified); the ground colour black, but with some degree of clothing of short brown hairs. The thorax (or fore body) has a white spot at each of the hinder angles, and a triangular spot between them. The wing-cases have a brown stripe down the suture, and outside this four white spots on the disc placed on a deep black longitudinal line (see figure); they are also sprinkled with small dots of white hair. The apical segments of the abdomen (which is not covered by the wing-cases) is grey. The antennæ dark, with the four joints nearest the head rusty colour; and the fore pair of legs is also rusty,—whence the name of *rufimanus*, or red-handed. The wings are ample. When the beetles are fresh, the markings show clearly, but very often they have been so much rubbed that the brown and white "pattern," so to call it, is removed, and little but the black ground of the wing-cases is to be seen.

The method of attack is for the beetle to fly to the blossoming Beans, and to lay its eggs on the young seed-vessel in the centre of the Bean-flower whilst it is still quite in embryo state (not large enough to be called a pod). From these eggs the grubs soon hatch, and make their way into the growing Beans. These grubs (or larvæ) are fleshy, wrinkled across, thick in shape, and have a small, horny, rusty-coloured head, and (so far as has been recorded) they are footless. Each maggot gnaws a round gallery into the growing Bean; sometimes there may be only one tunnel, sometimes several; and in its tunnel, amongst the dust and dirt consequent on its gnawings, the grub turns to the chrysalis, and thence to the beetle condition. But before it changes to the chrysalis state, it gnaws its gallery right up to the skin of the Bean, not through it; so that this circular bit of skin remains as a little round cap at the end of the burrow, just sinking in a little from the substance of the Bean having been hollowed out behind it, and when the time for the beetle to leave the Bean has arrived, it has only to press out what may be called the door of its tunnel, and effect its exit.

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* 'Seventh Report of Injurious and other Insects of the State of New York, U.S.A.,' by Dr. J. A. Lintner, State Entomologist, Albany, N. Y., 1891, p. 280.

Thus the fact of whether there is, or has been, presence of weevil-attack in the Broad Bean-seed may almost certainly be known. If there are one or more small round depressions where the skin of the Bean-seed is partly transparent, or again, if instead of the little depressions the round bit of skin has fallen off, and there are one or more little round holes like shot-holes right into the Bean, then it may be taken as a certainty that the Bean either is then, or has been, infested with the weevil.

In 1888 there was an unusual prevalence of this attack at localities in Kent, Essex, and Buckinghamshire, and also to some degree in Hertfordshire, and the observations then sent me,* being in several instances from leading agriculturists, gave much useful information on effects and means of prevention of the infestation which had not previously been brought forward.

Since then some advance has been made on various points, both as to structure, and amount of injury caused by attack of Bean and Pea Weevils, but still nothing like the attention is given to the subject which it deserves, and the following note, which I give (with thanks) from the number of the 'Scottish Farmer' for May 4th, shows the inconveniences that may occur from want of knowledge of the outward signs of grub or beetle-presence in the Bean.

The enquiry sent was as follows:—"A quantity of Beans were sent to a laundry for consumption by horses, and at the time of delivery they appeared to be perfectly free from any kind of pest. In a short time they were returned very badly infested by such insects as are sent herewith. Can you explain how this took place?"—(Q. C.)

To this I replied:—"Both of the parties in this Bean-seed case are in a sense right. The Beans would very probably show no external signs of the infestation within, excepting to those who knew what these signs were; and yet the beetles were within, being just on the very point of coming out. The Beans that appeared quite clean when sent off, would promptly be even swarming with the beetles."

If seller and buyer had been aware of the presence of the beetle-infestation within being shown by the little depressed bit of skin (as noted above) over the insect-tunnel, the whole perplexity and inconvenience would have been avoided.

Weevil-infestation is by no means confined to home-grown seed, and requests for information on this subject come in the common course. In the past season I received a communication from Mr. Wallace, of Eardiston, Tenbury, Worcestershire, with specimens of Bean-seed Weevil accompanying, and mention that they were "specimens of a beetle which is now emerging from some foreign Beans he had lately bought"; also a request for information as to what they were, and whether they were in any way likely to be injurious, so that, if necessary, steps might be taken to destroy them.

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* See my 'Eleventh Annual Report.'

In this case, as the Beans had been purchased for feeding purposes, Mr. Wallace, on hearing about the nature of the infestation, had them ground at once.*

On May 30th enquiry was also sent me as to *Bruchus*-infestation in imported Beans by Prof. John Golding, Lecturer on Chemistry at University College, Nottingham; these, he mentioned, were Italian-grown Seville Long-pod Beans, and he desired to know the name of the beetle, and whether it had been known to live in England, and infest the seed of an English-grown crop of Beans in the same way that the Pea and Bean Weevil does.

In the above and other cases of home or imported infestation of Beans by *Bruchi* sent me for examination, I have never seen any reason to suppose that the injuries were caused by the *B. fabæ*, but either certainly or presumably by the *B. rufimanus*; and in the notes immediately following I give some detailed observations on the *Bruchus fabæ* which might to some degree be described as the U. S. A. and S. African Bean-seed Weevil.

The *Bruchus fabæ*, Riley, the Bean-seed Beetle (at one time known as the *Bruchus obsoletus*, Say, and now as the *Bruchus obtectus*, Say),† was first recognized and described by Thomas Say from American specimens somewhere about the year 1832, and was for a long time considered to be a U.S.A. species; but it was not until the year 1860 that it was recorded (by Dr. Fitch) as infesting cultivated Beans, and the attack rapidly spread, mainly, it is believed, by means of infested Beans.

The following is the technical description by Say:—"Body blackish-cinereous, with a slight tinge of brown; antennæ not deeply serrate; thorax much narrowed before, cinereous each side, a slight impressed dorsal line; base with the edge almost angulated, central lobe almost truncate; scutel quadrate lightish, longitudinally divided by a dusky line; elytra with the interstitial lines having a slight appearance of alternating whitish and dusky; on the middle of the third interstitial line is a more abbreviated whitish line; posterior thighs with a black spine and two smaller ones. Length over one-tenth of an inch. The whitish or cinereous markings are not very striking; on the elytra they may sometimes be traced into two obsolete macular bands."

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* If it was merely a consideration of getting rid of the maggots or chrysalids, the grinding might be expected to be successful; but with the fully developed beetles it may not always be so, at least in former methods of grinding it was not; for John Curtis gives an instance of a cargo of 1000 quarters of large Beans imported from Sicily to Newcastle-on-Tyne in September, 1850, being so infested that the meal after passing through the millstones was apparently alive with the beetles, which took wing and flew about the mill in thousands.—'Farm Insects,' by John Curtis, note, p. 363.

† See 'Insect Life,' vol. vii., No. 5, p. 419; edited, by L. O. Howard, Entomologist of the U. S. A. Board of Agriculture, Washington, 1895; received whilst these notes were in preparation.

This beetle in general appearance is very like the Bean and Pea Weevils figured at p. 4, but is rather smaller, only about one-tenth of an inch long, and is generally described as of a tawny-grey, with more or less dull yellowish, and the main point of difference is the lesser quantity of the white markings. But there are some very remarkable points in the life-history, which I quote from the paper on Pea and Bean Weevils by Prof. Riley (late) and Mr. L. O. Howard (present), Entomologists to the U. S. A. Board of Agriculture.*

One point is the great number (as many as twenty-eight) of the individuals which may be found feeding at once in one Bean (a much worse state of things than we have present here). "A second point of difference, and one of great economic importance, is that the insects will continue breeding indefinitely in stored Beans." The eggs are primarily laid on the Bean-pod as with our kind, and, as with us, some of the beetles may come out in the following autumn, some in the spring. "If easy means of exit are not present, the females will soon begin to lay their eggs upon the stored and damaged Beans, and another generation will soon develop. This may go on indefinitely, or until the food supply is exhausted. The Bean Weevil continues to multiply in the stored Beans. These, when infested, are usually reduced at last to nothing but powder, and have no value as seed." †

Another very great peculiarity is the possession of three pairs of slender legs by the larva of this species (the *Bruchus fabæ*, Riley, now named the *B. obtectus*, Say) in its first stage. Thus, with the help of some other structural peculiarities, it can travel about among the Beans, and make its way within where it finds a spot on the seed suited for its entrance (*vide* paper quoted below).

For full information regarding this attack, with figures, &c., the reader is referred to the number of 'Insect Life' cited, also the exhaustive paper by Dr. Lintner (of which the title is given below ‡), together with the works and previous U. S. A. publications therein quoted; but having myself had the opportunity of observation of this species in connection with the great injury caused by it to Bean-seed in South Africa, I append some extracts from my paper on it given in my 'Notes on some Injurious Insects of South Africa.' *

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* See 'Insect Life,' vol. iv., Nos. 9 and 10, pp. 299—302.

† *Loc. cit.*, pp. 299—300.

‡ 'Seventh Report of the Injurious and other Insects of the State of New York,' by J. A Lintner, Ph.D., State Entomologist, pp. 255—288.

My observations were taken from specimens forwarded to me from Port Elizabeth, South Africa, including the weevil in all its stages, together with injured Beans, which, in some instances, contained the beetle fully or partially developed.

At the time, we were not able to identify the species of *Bruchus* with certainty, and therefore merely noted it as much resembling the *B. subarmatus*, Gyll. Subsequently, in the course of much correspondence on identification of Bean-seed Beetles between Dr. J. A. Lintner, Mr. Janson, and myself, it appeared, from type specimens submitted for comparison with our South African kind to Mr. Janson, that these were, without doubt, the *B. obsoletus*, Say, known also as the *B. fabæ*, Riley, and now, after much consideration of which of its various synonyms should be accepted as the authorized name, distinguished as the *B. obtectus*, Say.†

The localities of the species are Central and South America, Madeira, Canaries, Azores, Mediterranean basin, Persia, &c. Carried by commerce it is probably cosmopolite.

The full description by Mr. Janson is given at length in my South African notes, but the following note is sufficient here:—"Compared with our well-known Bean-seed Beetle (*B. rufimanus*, Boh.), it is smaller, rather more depressed above, has a narrower thorax, without teeth at the sides, and has the posterior femora furnished with a small acute tooth near the apex; the colour of the middle and hind legs and markings on the elytra are also different." For these see description at pp. 7–8, which, as we do not need two of the same beetle, I have selected for insertion rather than that in my own publication.

In regard to the amount and method of the infestation of the South African Bean-seed Beetles, I found in two of the Beans four holes where beetles had escaped, in another seven beetles had been present, and in another five beetles, or coloured chrysalids, were still within. But it was mentioned by Mr. S. D. Bairstow, of Port Elizabeth, from whom I received them, that "this pest when in larval condition reduces the interior of the seed to a fine powder"; and the ruinous nature of the infestation was thoroughly proved by the condition of the Beans sent, which ranged from presence of four, five, or seven beetle-perforations up to the Bean being completely crumbled to pieces.

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* 'Notes and Descriptions of a few Injurious Farm and Fruit Insects of South Africa,' compiled by Eleanor A. Ormerod, Consulting Entomologist of the Royal Agricultural Society of England; with descriptions and identifications of the insects by Oliver E. Janson, F.E.S. 1889.

† See 'Insect Life,' vol. vii., No. 5, p. 419. Washington, 1895.

On examination of the infested Beans, I noticed a difference in the method of maggot-attack (see pp. 25, 26 of 'South African Insects') from that of our *B. rufimanus*. Instead of the maggot-tunnels ending as soon as they came to the outside of the Bean, I found that they sometimes ran on just under the skin, so that their shape and the blackish colour of the insects when developed to the beetle state could be distinctly seen through the thin transparent coats of the Bean. Also, in some instances, it appeared from the gnawings that the maggot had made, or might have made, its entrance into the seed from the outside.

On microscopic examination, I found the larva of this South African Bean-seed Weevil (the *B. fabæ*, Riley, = *B. obtectus*, Say) to be not only, as is commonly the case with maggots of the *Bruchi*, much corrugated, but also that the three segments next the head were distinctly divided from each other, and that each of these segments was furnished with a pair of appendages placed in the common position of feet, and, as far as I could see, answering the purpose of the three pairs of claw-feet which are found in many beetle grubs. The appendages appeared to me to be one-jointed, and slightly conical or curved.* The specimens, being dried, were not in a wholly satisfactory state for examination; but in connection with the foot structure, of which the observations by Prof. Riley are given at p. 8, it would be of much interest to have further observations, which the recent appointment of a skilled Government entomologist in Cape Colony has now rendered conveniently practicable.

Injury from infestation to germination.—The amount of this is much the greatest in the case of the American and African Bean-seed Beetle. Where the whole contents of the Bean are destroyed, the mischief done is beyond question. But this weevil, having in ordinary course the habit of not only destroying much of the future seed-leaves, but of at times totally destroying the germ, is an especially injurious Bean pest. The following extract from detail of experiment at Kansas State Experiment Station on weevilled Beans gives useful information on this point:—

"Fifty per cent. started; of these three-fifths might have grown into plants, as the injury was restricted to the seed-leaves. But the remaining two-fifths were variously mutilated by the loss of a part or the whole of the germ or plumule, so that under no circumstances could they have made plants. Here then but thirty per cent. could have passed the germinating stage, and these, owing to more or less considerable injury to the seed-leaves, would probably have made plants of low vigour. In a check lot of perfect Beans of the same varieties, and in the same numbers, planted alongside, ninety-five per cent. germinated." *

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* See 'Injurious Insects of South Africa,' by Ed. (previously cited), pp. 25, 26.

From experiments made by the same observers, also at the Kansas Station, the great loss on weevilled Peas by deficient germination is fully proved, and is followed by the remarks of the joint writers of the paper—Prof. Riley, late Entomologist of the U.S.A. Board of Agriculture, and Mr. L. O. Howard, his successor:—"This evidence practically settles the long-mooted question, and it is safe to say definitely that weevilled or 'buggy' Peas should not be planted." Also, "The remark which we have just made regarding the germination of weevilled Peas will apply equally well to Beans damaged by *Bruchus*."

The amount of injury to one or other of the two kinds of seeds of course depends partly on the amount of what would have been the seed-leaves which is eaten away, and the consequent amount of removal of what would have fed the young plant in its first growth, and also, and very materially, whether it is the nature of the pest to feed on the germ in the seed. This makes an enormous difference in the practical importance of the two Bean-seed attacks under consideration.

It is proved that *fabæ* (=*obtectus*) will feed on the germ, but there does not appear to be proof that such is the habit of our own special long-known pest the *rufimanus*; but the experiments of Mr. Theodore Wood show with regard to this kind that risks arise from the use of even slightly injured seed.

From a number of infested seeds of *B. rufimanus*, Mr. Wood selected twenty; three of which had been perforated by three weevils, five by two, and twelve by *one only*. They were sown under favourable circumstances, and grew thoroughly well; but when the time for fruiting came the blossoms were few and small, the foliage faded, and several of the plants died without producing a pod. In Mr. Wood's own words:—

"Of the first three plants raised from seed pierced by *three* weevils, one was altogether barren, while the remaining two bore but three pods between them, none of which arrived at perfection. The next five, grown from seed tenanted by *two* beetles only, were slightly more fruitful, bearing in all six pods, of which five reached their full growth; two of these five plants, however, were barren. Upon the remaining twelve, the seed of which had but one perforation, I counted twenty-three pods, not more than ten of which arrived at maturity. Only one plant of the latter was entirely unfruitful. It will thus be seen that the twenty plants bore among them but thirty-two pods, in all of which less than one-half came to perfection."—'Entomologist's Monthly Magazine,' xxii. p. 114; 1885.

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* See experiments by Prof. E. A. Popenoe, of Kansas Experiment Station, quoted in 'Insect Life,' Nos. 9 and 10, vol. iv. p. 302. U.S.A. Department of Agriculture, 1892.

Mr. Wood notes that the kind of Bean he experimented on was not one of the most freely bearing kinds, six pods to a plant being the average yield; but if we look at the fact that, instead of 120 pods, which at an average yield was to be expected, only thirty-two pods were formed, of which fourteen pods did not reach full growth, and also that three plants were barren, the result points very strongly (as pointed out by Mr. Wood) to the presence of the infestation being highly prejudicial not to the germinating qualities of the seed, which appeared to be uninjured, "but to the reproductive capabilities of the adult plant."

I certainly think,—from the enquiries sent to myself as to the cause of deficient growth of Bean-plants when some way advanced to maturity, and when no reason can be found in state of ground or of weather, or from presence of any kind of insect or eelworm infestation on or in the plants,—that it would be very desirable for this point of bad effect of injured seed on crop development to be made the subject of field observation.

In regard to direct loss of weight, and consequently of money return, in the case of *Bruchus*-infested Beans, the following notes were sent me in 1888 by Mr. E. A. Fitch, of Maldon, Essex, who was (and is) well acquainted with the subject, both as an agriculturist on a large scale, and as an entomologist. Mr. Fitch reported with regard to damage by Bean-seed Weevil, *B. rufimanus*:—"In my own case a most moderate computation of loss of weight alone of 2*s*. per quarter, would give £65 12*s*., *i. e.*, 164 acres × 4 quarters the acre × 2*s*. per quarter."

To this Mr. Fitch added the following note:—"The much-talked-and-written-of Hessian Fly has not been nearly as destructive in Essex last year (1887) as this small beetle. The complaint of holey or bug-eaten Beans comes from all over the country, and is by no means confined to the Bean-growing lands; where Beans have been grown on our light land, they have suffered equally with those usually grown on the heavy land. I have myself delivered Winter Beans in other years weighing 19 stone 4 lbs. (67½ lbs. per bushel); and I hear from the corn merchants that nothing over 18 stone can be expected this year; a year in which condition, and consequently weight, is exceptionally heavy, the loss being entirely due to the ravages of the *Bruchus*."—(E. A. F.)

Without going into details as to the Beans being unsaleable (which does occur) from maggot-injury, the above gives some definite account of what damage may be.

PREVENTION AND REMEDIES.—The first of these,—and a method which (if buyers could but be persuaded to adopt it) would save loss from deficient growth of crop to begin with, besides subsequent loss from recurrence of beetle-attack to the seed,—is *thorough examination* of the Broad or Tick Bean-seed before purchase. If the seed has been infested (which is shown by the holes), the farmer sows a damaged article which will not yield him a full return; if he sows Beans with a few little pits of transparent skin about as big as would cover a common shot-hole, he at the same time (unless he has had the trouble and expense of killing the pest in the seed) *sows a coming crop of Bean-seed Beetles!* If the buyer has a doubt as to the state of the seeds, just splitting some open with his knife will show him exactly what their state is. Autumn-sown Beans are much more likely to contain infestation than the spring-sown, as many of the beetles will still be within.

There is often a little black spot on Beans which have been attacked, caused apparently by the original passage of the maggot into the young seed. This spot, when seen under a magnifier, looks much as if a small hot needle had been driven into the Bean, and the edge of the little round hole, and just a little way round it, had been burnt black. On opening the seed just below the black spot, I have usually found the commencement of a larval gallery, or a little chamber, as if the young maggot had fed there for a while before travelling onwards. But the spot is so indistinguishable without a magnifier, that practically it is little use in showing infestation.

A safe and easily practicable method of dressing infested Beans so as to kill the contained infestation is that (recommended by Mr. Geo. Street, of Maulden, Ampthill, in 1888) of application of blue vitriol and McDougall's Sewage Carbolic. On May 10th in that year Mr. Street wrote me (with regard to whether the Beans would be injured thereby) that they had made wonderful progress, and the result, so far as he could see, was perfectly satisfactory. "The dressing applied to the Beans was used in a similar way to that used for seed-wheat. Formerly we used blue vitriol only, but the addition of McDougall's Sewage Carbolic leaves a smell, which to some extent prevents birds eating the seed-corn. I am inclined to think the carbolic alone would be sufficient, if a larger quantity was used. We used 6 bushels of Beans, 6 quarts of water, 1 lb. of blue vitriol, and a pint of Sewage Carbolic. I am inclined to think that Beans should be dressed some few days before they are sown (as the skin is thick), and turned over with a shovel every day. Those which escaped the liquid dressing might be killed by the strong dust which would be formed when the Beans were again dry."

Another correspondent in the same year mentioned that he had "dressed all the seed with Calvert's Sewage Carbolic Acid, of such strength as to kill all the insects in the Beans without damaging the seed."—(See 'Twelfth Report on Injurious Insects,' by Ed., p. 28.)

In my own experiments (quoted in same Report) I found that, if the Bean-seed was placed for a short time to soak, the water passed through the thin film of skin of the Bean into the grub-tunnel, and so soddened the powdery dust and dirt in which the beetle was lying within, that the insect could not free itself, and was killed. If this was found to answer on a working scale, it would save the expense of chemicals; but there might be damage to the Beans if from any circumstances they could not be sown soon after being wetted.

Keeping Bean-seed shut up until all the weevils have come out and died is a method which may be used with our Bean Weevil-attack; but is no use against what may be called the U. S. A. kind, in which in captivity the successive generations lay eggs, and the maggots feed in the Beans till the seed is destroyed.

Bisulphide of carbon.—The vapour of this is stated (p. 276 of Dr. Lintner's Report previously cited) to be an infallible means of killing Bean and Pea Weevil. "The infested Beans may be put in some tight vessel, box or bin, with a cup containing bisulphide of carbon upon them, covering up closely, and leaving for a day or two." The heavy vapour is stated to kill all animal life present, without injury to the germ or impairment of utility of the Beans as food; only, as the *vapour is inflammable*, precautions must be taken not to bring a light near it. The plan has been much used on a large scale by filling a building with sacks of Peas, making it air-tight, and then, by means of a special apparatus, driving in bisulphide of carbon. This was used by Pea-growers in northern New York State in a time of great emergency to check increase of Pea Weevil, and will be found noticed as referred to below.*

In the above observations I hope it will not be thought I have gone into the subject at unreasonable length, as it is in the view of meeting a constantly recurring trouble which might be greatly lessened; and also entering on the still worse Bean pest which, though there does *not* appear to be the slightest reason to suppose we ever have had it in this country, certainly is in one at least of our colonies a serious crop evil, and may by possibility some time be imported here.

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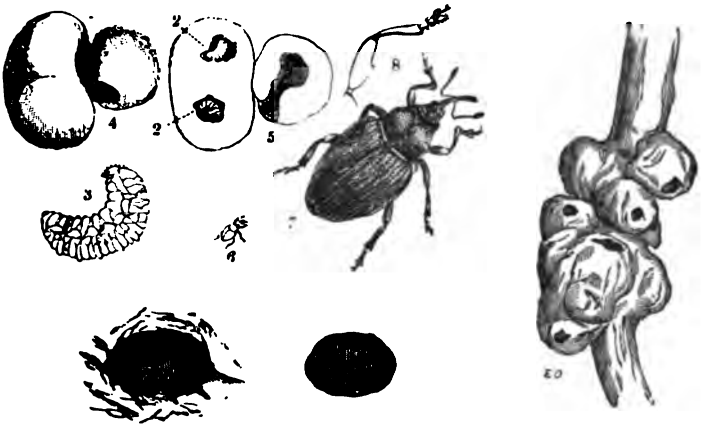
* Bulletin 58. Michigan Agricultural Experiment Station, State Agricultural College Association, 1890. 'Insecticides' (Bisulphide of Carbon), pp. 8—12.

CABBAGE.

Cabbage and Turnip Root-gall Weevil. *Ceuthorhynchus sulcicollis*, Gyll.



Ceuthorhynchus sulcicollis.—1–5, gall and maggots, nat. size and mag.; 6 and 7, weevil, nat. size and mag.; 8, leg of weevil, mag. Also cocoon, and cocoon in earth-cell, and Cabbage-root with galls, drawn from life by Ed.

The small knob-like excrescences on Cabbage-roots (and also on Turnip-bulbs), which are caused by the presence of the grub of a small weevil-beetle, are a most common malformation, and though the plants would be better without them, still they are not generally considered to do very much mischief. Last spring, however, the first observations of their appearance (which were sent at the beginning of April) were of some especial interest, as showing that the grubs were in no way injured by the long-continued and very unusually severe cold of the preceding winter, which could only be said to begin to break up generally towards the end of February; and also the specimens sent showed in one instance, and on the broad scale of field cultivation (as they were samples of an intended purchase of 4000 plants), an amount of serious injury from the severity of gall infestation which I have never met with before.

On the 4th of April Mr. Steabbens, of St. Albans, sent me samples of a large number of Cabbage-plants submitted to him for purchase, all of which I found to be infested with weevil-galls. In a few instances the mischief was done, the gall was open, and the outside partly broken off and gone, as well as the maggot, but for the most part the grubs were still present. Some of the plants sent showed only a few of the lumps or galls, averaging about half an inch across; but sometimes they had larger lumps of galls grown together, so as to make compound globular swellings up to about half an inch by one inch in diameter, often with passages gnawed by the maggots from one confluent gall to the other, so that the inside was a brown, discoloured, roughly eaten-out chamber, more or less advanced towards decay. This rough chamber might be found encircling very nearly the whole of the Cabbage-stem a little below ground-level, and many of the plants were so much smaller for a short length above the galls as to appear as if the growth had been appreciably stunted by the gall-presence.

The maggots were of various ages, and in some few instances had not yet cleared away much of the inside of the smaller galls, which were still only a little decayed and discoloured within.

In one instance where there was a large mass of confluent galls, about four or five grown together, I found the eaten-away hollowed chamber extending nearly round the stem, without any maggots present excepting at one extremity, where a fairly sound gall remained with only a hole for passage eaten into it; and in this gall I found four maggots, apparently the previous tenants of these other galls.

The Cabbage-plants averaged about eight to ten inches in length, and their advanced size, and also the size of the galls, made remedial measures difficult, if not impossible. The maggot gnawings went down to (or well into) the surface of the root, so as entirely to destroy the outer part, in some cases to a depth ruinous to the plant, unless subsequent circumstances might cause a good development of roots above the injured part. If the galls had been cut or scraped away, this, at the size to which they were grown, would have made such large wounds that it would have been very far from certain that they would heal; and if not cut off they made a centre for spread of decay from the gnawed tissue and the maggot-dirt in the galls.

The samples were a portion of two hundred score of plants, and on enquiry the sender told me that of these some were more, some less, infested than the specimens put in my hands; but that all except about one in nineteen or twenty were galled. This was the very worst instance of Cabbage-root gall attack that I have ever seen, and I strongly advised return of the plants, which were considered to be practically useless, and such return was intended to be made.

Other communication sent gave nothing new; only showed that the weevil grubs were in good health, and some of them remarkably well-grown specimens at the beginning of April.

If this attack was usually seriously hurtful it would be worth while to draw attention to the absolute certainty of perpetuating it by growing Cabbage year after year on the same ground; but as the case stands perhaps it does not very much matter.

It is an infestation, however, which is remarkably little liable to be checked by natural causes. The hard blackish weevil beetles, only about the eighth of an inch in length, of the shape figured magnified at 7, p. 15, are hardly observable as a matter of field infestation. The maggots produced from the eggs laid by the female beetles are at first hardly perceptible in the galls which their presence causes. They lie there as thick-made whitish or yellowish and legless grubs, with the head furnished with strong ochre-coloured or chestnut jaws, armed with two well-defined teeth at the extremity, with a third, which is sometimes much smaller, and sometimes little more than a tubercle on the inner side,* and can feed, well protected in the thick fleshy gall-growth, unless dragged out by insectivorous birds, until the time comes for them to leave the gall and turn to the chrysalis-state in the earth.

Here again their customs of life are a great protection to them. In my own investigations of the habits of the grubs I have found that on being disturbed, even if not apparently quite full-grown, they almost invariably buried themselves in the earth and constructed their earth-cases. These cases (where I was able to watch the process) were built up by the maggot holding some portion of its surroundings with the tail-end, and then adding material until it formed for itself an obtusely oval case, lying in the earth chamber from which the material had been taken. If the earth-case is broken before the maggot has turned to pupa, it will thoroughly repair it, or in winter I have found that they will bear being frozen stiff, and on being thawed will at once bury themselves and begin constructing or reconstructing their cases.

The time occupied from disappearance of the maggot to appearance of the beetle, in the instances of Turnip and Cabbage infestation which I watched in summer, was never less than about fifty-four days, and never more than two months. The infestation is to be found at the roots of many kinds of the Cabbage tribe, as, for instance, Rape, Common and Swede Turnips, Cauliflower, and Hearted and Red Pickling Cabbage, &c., and may be present during all the warmer part of the year in its different stages, and even during winter maggots are to be found in the galls.

It is often to be found together with the fungoid disease variously known commonly as Club in Cabbage, and as Anbury or Finger-and-Toe in Turnips; but the two attacks may be distinguished by the root-galls being mere lumps, single or several grown together, and smooth and healthy looking outside, and inside either solid or (as attack progresses) more or less hollowed out until the maggot's work is done, and it has left the empty decaying gall. The Club is a great irregularly-formed mass which gradually cracks and putrifies.*

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* See figs. of jaws in paper on Turnip and Cabbage-gall Weevil, in the 'Entomologist,' vol. x., by E. A. Ormerod.

A most commonly used remedy for gall on young Cabbage is just scraping off the galls with the nail (or in any convenient way) at the time of planting out. But where any attention is given to the subject the principle of prevention lies in such measures as rotation of crop, which will allow of the beetles being developed and gone before a crop suitable for their infestation is again put in. Also in destroying the infested stumps by burning. If they are merely thrown aside the weevil-grubs will feed on uninjured within the galls, and in due time go through the later stages of their development undisturbed. Therefore leaving the infested stocks about, or digging them in, or throwing them in rot-heaps, are all of them practices leading to continuance of weevil-presence.

Trenching does good in garden cultivation by putting the weevils down to a depth from which they cannot come up, and in the case of this insect infestation, as well as in the Slime-fungus infestation of Club and Finger-and-Toe, the application of lime or gas-lime is beneficial.

CORN AND GRASS.

Antler Moth; Grass Owlet Moth. *Charæas graminis*, Linn.

CHARÆAS GRAMINIS.—Moth and Caterpillars.

Antler Moth caterpillar attack, it will be remembered, was one of the most widespread infestations reported in 1894, and it was of considerable interest to find whether it would reappear in the same district in the past season. This it has done to some degree, but by no means to the extent recorded in the 1894 attack.

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* Large figures from life, in photogravure, of Club, Anbury and Finger-and-Toe, full account of the attack, and measures found serviceable in greatly lessening the injury caused by Slime-fungus, or *Plasmodiophora brassicæ*, will be found in my 'Sixteenth Report on Injurious Insects.'—ED.

In that year the first reports, which were sent on the 22nd of June and a few days later, noted the caterpillars as making considerable havoc to the grasses on the hill-pastures in the western part of Roxburghshire, also in the adjoining counties of Dumfries and Selkirk; likewise the appearance (in immense numbers) of grubs, doing extreme damage in the highlands of the South of Scotland, was reported.

The complete observations of the summer of 1894 (see 'Eighteenth Report on Injurious Insects,' with names of contributors appended to their communications) noted this caterpillar outbreak as "having been more or less general over the hill country of Kirkcudbrightshire, and over the adjacent sheep-farms in Ayrshire, the Dumfriesshire hills, and the contiguous districts in Lanarkshire, Peebles, Selkirk, and Roxburgh. Seven counties were affected to my knowledge, and there may be more."—(R. S.)

The most westerly locality from which I had a report was Hawick, in Roxburgh, and this, measuring across to the south-eastern border of Ayrshire, would give a measurement of the length of the more or less infested area of about a hundred miles; the greatest breadth might be estimated at about thirty miles.

In the past season (that is, 1895) the first observation of the appearance of the Antler Moth caterpillars was sent me on the 24th of May, by Mr. W. Gray, from Tanlawhill, Langholm, Dumfriesshire. This was nearly a month earlier than the first report of 1894, which was forwarded on the 22nd of June; and the grubs sent by Mr. Gray were still of various sizes, from very small to perhaps about a third or half-grown. Mr. Gray observed:—"I send you some of the Antler grubs, which were so bad last year. They have made their appearance again here this year, and I fear will be quite as bad as last season. . . . I hear that they are very bad in Roxburghshire."

No more information was sent me until, on the 12th of September, Mr. Robert Service, of Maxwelltown, Dumfries, who had observed the infestation in the previous year over a large extent of country, wrote me as follows, in reply to my enquiries:—

"I have not been quite so much amongst the hills this season as usual, but with the exception of a patch of country just on the extreme corner of Lanarkshire that runs into Dumfriesshire, just behind Queensberry, I neither saw nor heard of the ravages of the 'hill-grubs' to the eastward of Nithsdale. At that place, at the farm of Nunnerie, there was a good deal of damage done to the grass in May and early June.

"On the westward of Nithsdale there was again a pretty wide-spread attack in the parish of Carsphairn.* These were all that I could hear of, and they did not attract any public notice. Compared with last year, the attacks in both localities named were insignificant."—(R. S.)

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* Carsphairn, a district in the northern part of the shire of Kirkcudbright, where the Antler Moth caterpillars did much damage in 1894.

The chief points of interest in this attack, independently of its great extent in the first year of its appearance, appear to me, firstly, as shown by the paper (see p. 32) on the Spotted Daddy Longlegs or Crane Fly (the *Tipula maculosa* scientifically), that, bad as the mischief is that is caused by the grubs of the Antler Moth, yet that the whole of the destruction on the pastures is not always to be laid to their charge; and secondly, that although by those not accustomed to notice insect presence, excepting when in full career of ravage, the great outburst of 1894, and presumably the lesser one of 1895, were looked on as sudden and unaccountable appearances, yet this was not the case; both had their forerunners.

On the 7th of July, 1894, Mr. Robert Service, of Maxwelltown, Dumfries, a perfectly well qualified local observer,* remarked, regarding the presence of this "hill-grub":—"Just now complaints are rife from farms in many parts of the wide district lately ravaged by the Voles. As usual, the farmers look on these 'hill-grubs' as very sudden arrivals, but this is not the case, for last autumn [1893, Ed.] the moths which these larvæ produce were in extraordinary swarms, and far in advance of their normal numbers." And in the following year (1894), on the 31st of August, Mr. Service wrote to myself, that "on Thursday (yesterday) I saw a wonderful sight on a hill-side in Upper Nithsdale, on a farm where the 'hill-grubs' had not been conspicuously present. About 10 a.m., when I arrived at a place where *Juncus squarrosus* was the prevailing plant, the Antler Moths were in full flight,—in thousands and thousands,—in all directions. This flight continued till well after midday, when it in a great measure ceased, although the moths were to be seen here and there the whole afternoon. Just before the gloaming they began to fly very numerously."—(R. S.)

How far alternating appearance of grubs and moths may have occurred elsewhere in the infested district, we do not know, not having the benefit (except in the above various local observations) of the notes of a skilled entomologist; but so far as they extend the above records are valuable for future guidance; and *precise* coincidence of locality in moth and grub is not of great importance in considerations of this kind in a greatly infested district, more especially in a case of this nature, where the larvæ are notable for their migratory powers.

The figure at p. 18 shows the size and markings of the moth and caterpillars. The former takes its name from the somewhat antler-like markings on the brown fore wings; the hinder wings are brown or greyish. The eggs are very numerous, and are laid in the ground, or at the base of the grasses on which the grubs feed. These eggs soon hatch, and in regular course the young caterpillars feed awhile on the soft parts of the grass-shoots, then hybernate and come out again to feed in the following spring.

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* See "Notes for Naturalists," in 'Dumfries Courier and Herald,' July 7th, 1894.

The caterpillars when full-grown are about an inch in length, with brown head, body of a bronzy colour, excessively shiny on the upper part, and divided by three pale longitudinal lines, two of these pale stripes meeting, or almost meeting, above the tail (see figure, p. 18), and another pale and narrower line running lengthwise beneath them.

It is evident from last winter's experience (that is, from the temperatures of February, 1895), that a severity of cold both much greater and also longer continued than is usual in this island does not avail to clear off this pest. Nor can this be expected if we consider the localities recorded in the observations on the geographical distribution of this infestation in Finland, by Prof. Odo M. Reuter.*

Prof. Reuter begins his observations as follows:—"The Grass-Owlet† (*Charæas graminis*, L.) is widely distributed, especially in the north. In Greenland, Iceland, Scotland, Courland, Russia, Norway, and especially in Sweden, the devastation of meadows by the caterpillars of these moths has long been known. . . . In the last ten years [preceding 1892, the date of report, Ed.] the caterpillars of the Grass-Owlet have also appeared in Finland in very destructive numbers. In the year 1880 ravage from them was still unknown; only in the parishes of Saltvik and Geta, in Aland, was there some amount of harm caused by these grubs.‡ This year, however, in nearly all the Governments, was known as being a bad hay-year. The cause assigned for this was the cold spring, and, later on, the long-continued drought.

"But by the middle of June [in 1881] the caterpillars suddenly appeared in the district of Helsing (Government of Nyland), and shortly afterwards enormous devastations were reported from many places."—(O. M. R. *loc. cit.*)

The further spread of the infestation year by year in Finland, up to 1891 inclusive, is given by Prof. Reuter, with names specified of the Governments, and of the parishes or localities therein, to which its seriously injurious presence extended. To these are added some considerations of the geological nature and characteristics (as of soil, neighbourhood of coast, &c.) of the land affected, the nature of pasture-land attacked, and details of the migration of the caterpillars, when their ravage was complete in one place, to other grasses or crops, as to Oats, in a lesser degree to Barley, and occasionally to Rye.

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* 'Zur Kentniss der geographischen Verbreitung der Graseule in Finnland,' von O. M. Reuter, mit einer Karte. Fennia, 5, 12. Helsingfors, 1892. Knopio O. W. Backmans boktryckeri. 1892.

† "Eule," in German, equivalent to Owl or Owlet, or *Noctua*, scientifically referring to the nocturnal habits of the moths.

‡ Aland is the chief of a group of small islands lying to the west of the south-western extremity of Finland.

Prof. Odo Reuter's paper, which extends to ten pages, with a good map showing localities and degrees of attack, appears to me of rare value, as giving what is so seldom obtainable—information from a skilled and reliable source of the first appearance of a bad crop-pest in a great country, with data year by year of its injurious spread until it has made good its foot-hold. It gives much for consideration, and I beg to offer my best thanks to Dr. Enzio Reuter, Consulting Entomologist, of Helsingfors, for presenting me with a copy of his brother's work.

The chief remedial measure which has been practised in this country is firing the pastures, and thus destroying the heath and mountain plants together with the grass, and in this way getting rid of the caterpillars sheltered amongst them. In the very bad attack of these caterpillars to mountain ground in Glamorganshire in 1884, the smoke of the mountain fires was especially mentioned as showing the large area and the severity of the infestation requiring such measures to check it.

But besides the direct destruction of the pests by fire, there is the important consideration that the caterpillars have been found to have an intense dislike to the burnt surfaces, and will move away with great rapidity when in their migrations they come on burnt land. Thus it would appear a band of fired ground might be used as a protection where the migrating bodies are moving to more valuable crops, and also in directing their course towards any neighbouring stream or pool, or peat-hole, which even in natural circumstances the caterpillars on the march will fall into in such extraordinary numbers as to make it appear that whether wet or dry they continue their course right onward.

In my reports of 1884 it was noted that at Treorky Station (on the Rhondda branch of the Cardiff and Merthyr Railway) the mountain brook running from the Fforch Mountains was thick with myriads of these caterpillars, which had been drowned by falling into it during their march across the side of the mountain.*

In 1894 Mr. Service reported that a party fishing for five or six miles down the river Ken, in Kirkcudbrightshire, found all the trout they caught perfectly crammed with these caterpillars.

Their determination in their onward march may certainly be well turned to account by digging ditches across their path. These, if filled with water, will destroy myriads, or, if dry, may be equally well utilized by driving sheep along them, or otherwise trampling the caterpillars to death; but where it is practicable, directing the migratory hordes into the water by judicious firing of the dry grass and plants appears to be the simplest course.

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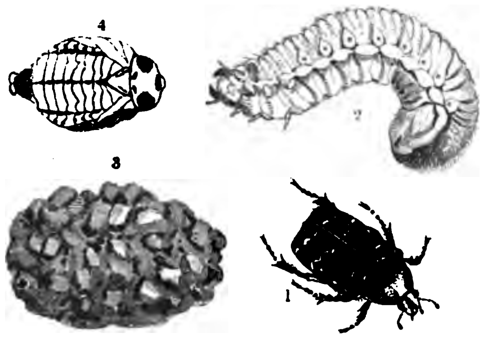
* See my 'Eighth Annual Report on Injurious Insects.'—Ed.

CHAFERS:—**Golden Chafer.** *Cetonia aurata*, Linn. **Rose Chafer.** *Phyllopertha horticola*, Linn. **Common Cockchafer.** *Melolontha vulgaris*, Fab. **Summer Chafer.** *Rhizotrogus solstitialis*, Linn.



CETONIA AURATA, Golden Chafer.—Beetle, grub, back of pupa, and earth-cocoon.

Presence of the four kinds of Chafers mentioned above was reported during the past season. Of these, the three kinds first named are always more or less present, and sometimes (especially in the case of the Rose Chafer) seriously mischievous. The fourth of those named, the Summer Chafer, although sometimes noticeable in great numbers, and (as I have seen them myself on the Severn cliffs in west Gloucestershire) fairly loading the low-growing bushes, or trailing boughs of the wild *Lathyrus* Pea, has never been reported to me as causing real damage in this country, either in the beetle or maggot state.

All the above kinds of chafers are much alike in their method of life. The beetles feed chiefly on leafage of various kinds, or on flower petals, or stamens. The Cockchafers mainly frequent leafage; the Rose Chafers, although hurtful to leaves, are very injurious to various kinds of flowers, especially to Roses; and the Golden Chafer infests flowers, and is especially injurious to Strawberry-blossom, and also to Turnips left for seed, by destroying the anthers of the stamens; the Summer Chafer is seen on the Continent hovering in vast swarms round different kinds of trees, but does not appear to be credited with doing much harm in beetle state.*

In their grub or larval state the four above-mentioned kinds of chafers are much alike, excepting in difference of size when full-grown (see figures).† (That of the Summer Chafer is not given on account of its similarity to that of the Cockchafer.) They are fleshy, whitish or yellowish grubs; somewhat cylindrical until near the tail, which is enlarged to a kind of blunt bag-like shape, and is of a bluish colour from the enclosed excrementitious matter. The head is large and horny, and armed with strong jaws; and the grubs are furnished with a pair of very noticeable legs on each of the three segments next to the head.

All the four kinds of larvæ (or grubs) are so very much alike in their first stages, that I believe it is impossible for any one but an expert to distinguish certainly between them. After a time they are distinguishable (in a general way) by their respective sizes; but for practical purposes it may, I believe, be safely considered that where a great infestation of some special kind of chafer-beetle has been noticed on special fields, that the chafer-grubs found on that spot are the progeny of the preceding beetles. This may seem too obvious to need pointing out; but I have known pseudo-scientific investigation come to a very inaccurate conclusion for want of a little attention to the above considerations.

The grubs of the above-mentioned kinds of chafers feed much at grass-roots, but are by no means wholly confined in their ravages to grass-land. The Cockchafer grubs may be found at roots of various field-crops, fruit-trees, as Apple, Plum, &c., and even at Larch-roots; and the Golden Chafer grub is especially injurious to Strawberry-roots, and is also to be found in ants'-nests.

The Golden Chafer, sometimes known as the Green Rose Chafer, *Cetonia aurata*, Linn., figured at p. 28, is of a bright metallic green or golden green above; coppery, with a rose tint, below; the wing-cases are punctate, and marked with spots or streaks of white or ochreous colour, so placed as often to look like cracks across the metallic green of the wing-case. The horns are ended by a club much like that of the Cockchafer (see figure, p. 80), excepting that it has only three leaves or plates, whereas that of the Cockchafer has seven plates in the male, and six in the female. The wings are large and membranous, of a brownish colour, with horny veins; and when the beetles are seen in flight on a sunny day they are very conspicuous objects, and, if quietly watched, remarkable for the care with which they will choose a place (presumably) for egg-laying by floating round in the air till an available crack in the ground is selected, and then with good aim sweeping down into it and disappearing.

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* *Vide* Kaltenbach's 'Pflanzenfeinde,' p. 86.

† In 'British Coleoptera,' by Canon W. W. Fowler, it is observed at page 50, vol. iv.:—"The larva of *Rhizotrogus* appears very closely to resemble that of *Melolontha*, and does not need a separate description."

In the neighbourhood of Isleworth, where Strawberries are grown in fields of many acres to supply the London market, I have had the beetles brought me in great numbers, and to a greater or lesser extent they are a very common infestation; but the following note, sent me on the 25th of May (1895) by Mr. Leonard Micklem, from Yardley House, Chingford, Essex, records such an unusually numerous appearance of this beetle that it is worth adding to former observations:—

"I am sending you by post three specimens of a green beetle which is becoming an insupportable pest in my garden, in the hope you may be able to suggest some method of eradicating it. The beetle appears annually with the Apple-blossoms, which it devours greedily, and is now paying attention to Medlar and Iris-bloom. My gardener has killed more than 2000 already this season, but even this appears to effect no diminution in their numbers."

A few days later Mr. Micklem, writing further regarding the Golden Chafer attack, remarked that the capture that day was 873, "and this in spite of daily destruction since their first appearance."

The life-history, just shortly given, appears to be that the chafers lay their eggs in the ground, including in this such places as heaps of rich earth and old cucumber-beds in gardens, and the maggots feed on roots, as of grass, &c. Probably also they are very injurious in Strawberry-beds, as John Curtis notes:—"I have seen very fine young plants die suddenly, and on taking them up, the roots had invariably been eaten through close to the surface, and a large maggot was always found a little below the spot."—(J. C.)*

The grubs (says the same authority) may be distinguished from those of the Cockchafer, which otherwise they very much resemble, by being downy, and covered with transverse series of short hairs, and the *feet are pointed*, whereas the feet of the Cockchafer grubs are blunt, and *rather dilated at the tips*. Also the Golden Chafer grubs have a large horny bright-coloured rusty spot on each side of the segment next the head.

The grubs are considered to live underground for two or three years, and then (in the second week in June, in an instance specially watched) to form their pupa-cases in the ground, covering the outside of these large earth-cocoons with pellets of earth or dirt which have passed through their bodies (see figure 8, p. 28).

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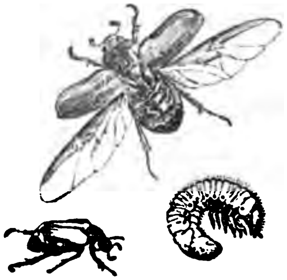
* '*Cetonia aurata.*' Paper by Ruricola (= John Curtis) in 'Gardeners' Chronicle,' vol. i., page 452, 1841.

The duration of the attack of the beetles depends very much on the weather. In 1841, when they were specially watched by Curtis, he noted:—"This spring, after feasting on the Strawberry-blossoms, they proceeded to a bed of Turnips in flower, which was reserved for seed, and they are now making a repast of the Roses; thus they migrate from one set of flowers to another until September if the seasons be fine, but if wet and cold weather sets in they become paralyzed and die."

Measures of prevention and remedy are very similar to those for other chafer infestation mentioned at page 32.



PHYLLOPERTHA HORTICOLA, Garden or Rose Chafer, and maggot, natural size; and magnified with wings expanded.

The Rose Chafer, or Garden Chafer, figured above, has for some years back been one of our especially bad pests, causing very serious injury to grass-land, and reports of it are again given to show the wide extent of its continued ravages. In Norfolk, on the east of England, and in Galway, on the west of Ireland, it has been doing its mischievous works; and on the Welsh mountains near Barmouth, as amongst the gardens of Surrey and other localities in beetle state, and at grass-roots in various localities in grub state, its obnoxious presence has been remarkable.

The beetle is of the shape and size figured above (lower figure or natural size); the head and fore body bright green; the wing-cases bright tawny. The grubs are exceedingly like those of the Cockchafer, only smaller. They are white or ochreous, with chestnut or ochrey-coloured heads, and jaws darker at the tips; when at rest they lie with their bodies curved, but when disturbed they straighten themselves out, and are very active; and lately I have found, by timing the progress with the help of a foot-rule and the second-hand of my watch, they could travel from five to six inches in about half a minute. When full-fed they turn to the chrysalis-state in cells some way beneath the surface of the earth.

On the 3rd of June information was sent me by Mr. P. H. Foulkes, from the University Extension College, Reading, of beetles, which proved to be Rose Chafers, having been sent him from a locality in south Hampshire, where a lawn had been attacked, and considerable damage done.

One of the earliest observations, however, of appearance of the Rose Chafer beetles in great numbers in the past season was sent on the 6th of June by Miss Hampson, from Tyn-y-Celyn, Llanelltyd, Dolgelly, N. Wales. In this Miss Hampson mentioned that on the previous Sunday (that is, the 2nd of June) swarms of the enclosed insect appeared on the neighbouring mountains above the Mawdach or Barmouth River, and that, at the time of writing, they were at the lower levels also.

At the above date notes were also sent by Miss Dobell, of Detmore, near Cheltenham, of reappearance of the Rose Chafers in great numbers on her fields, where they have done much mischief in previous years, and from which she has obliged me from time to time with observations of these and of Cockchafer attack which was likewise present. On the 6th of June Miss Dobell wrote as follows:—"You will, I think, be sorry to hear that we have the 'Rose Beetle' in swarms. I suppose these beetles are from the grubs of 1892. We first saw them on Monday, June 3rd. They began to rise about 12.30, and by one o'clock my *Clover* was covered by couples of beetles. My nieces set to work and gathered them into cups with water, and had to be very careful to put the hand *under* the Clover before touching it, or they fell into the grass. For two days we have been picking with the help of a boy, and gathered a large pint and a quarter of the poor little things; but to-day I have given up in despair, for the whole field, when the sun came out, was black with them flying. My man says all my neighbours' fields are the same. I sent him up to my top field that is not put down for hay, and he said there were none on the two sides, but there seemed to be a band in the middle thick with them, like a swarm of bees, going to other fields. I have none on my Roses or trees; all seem on the flowers or Red Clover, that we have a great deal of."

On June 15th Miss Dobell reported further:—"I am sorry to say the Rose Beetles kept on in thousands for a week, flying about over the fields till 1.30 or 2, and then again settling on the Clover till next morning, where for a week they kept flying; after that we have had about fifty or more picked off the yellow Scotch Roses. Only a *very* few have been on the other Roses."

The following observation, given in the 'Dublin Farmer's Gazette' for June 15th, 1895, at p. 328, is of a good deal of interest as showing the presence of the *Phyllopertha horticola*, or Rose Chafer, and also the serious damage caused by this beetle to various kinds of garden crops, as far west in Ireland as the county of Galway:—"*Co. Galway.*—

Every leaf in my garden on Peas, Roses, Strawberries, Raspberries, is being eaten, leaving nothing but lacework, by what I think is the Rose Bug. I never saw such a quantity. The hearts of the Roses are swarming with them." Samples accompanying were submitted to Mr. G. H. Carpenter, Consulting Entomologist to the Royal Dublin Society, who identified them as the *Phyllopertha horticola*, giving the requisite advice.—(Ed.)

On June 18th, I was favoured with a note from Dr. C. Theodore Williams, of 2, Upper Brook Street, London, W., regarding beetles which were infesting Roses in his garden at Witley in Surrey. These also proved to be the *Phyllopertha horticola*, or Rose Chafer, and were doing much mischief by eating "the petals of all the Roses."

On the 20th of June I had the following useful note sent me by Mr. T. P. Newman, of Hazelhurst, Haslemere, Surrey, in which district * the Rose Chafers, which were so mischievous in beetle state to Roses and various kinds of leafage, and most seriously destructive in maggot state to roots of grass in pasture-land in 1893, are still troublesome.

Mr. Newman remarked:—"There would seem to be no royal road to destroying this pest; but it is comparatively easy to destroy many thousands, and this must surely have some effect in both present and future depredations. The beetles are especially fond of the fully-opened and fading blossoms of *Rosa rugosa*, as well as of the Scotch, Austrian, and Persian Roses. It is quite worth considering whether it is not worth while to plant a few bushes of *Rosa rugosa* to attract the beetles away from fruit-trees. They cluster in groups of a dozen or more on a flower-head.

"By holding a small fish-can under and tapping the blossoms, the beetles, which are very suspicious, drop into the can; as they are sluggish in the evening, this is the best time. In case they are lively the lid of the can is shut down on them. Scalding water kills them, and to make sure of destroying the eggs, they are finally burned on the rubbish-heap. In this way I destroyed about a thousand a night in about half an hour for three or four nights. The main attack does not last much longer. Isolated specimens and pairs are, however, still abroad."

This observation of Mr. Newman's as to short duration of the main attack is well worth notice, for in an attack of this kind it is very apt to happen that while people are thinking what to do, or whom to ask about it, the mischief for the present attack, and egg-laying for the next, is completed, and the insects gone.

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* See my 'Seventeenth Report on Injurious Insects,' pp. 24—26.

PHYLLOPERTHA HORTICOLA, *Garden or Rose Chafer, seriously injurious to young crops of field Turnips in Norfolk.*

On June 15th I was favoured by Mr. E. A. Atmore, F.E.S., of King's Lynn, Norfolk, with observations of the great abundance of the Garden or Rose Chafer Beetle in that neighbourhood, and that (by that day's post) he had received news of great damage being done by this pest to the young Turnips near West Dereham, Norfolk, and that it was stated fifty acres sown with Turnip would have to be destroyed by reason of the ravages of this beetle.

Mr. Atmore, who is a skilled entomologist, as well as an experienced observer, naturally thought that there might be some mistake, and that it was really the Turnip Flea Beetle (*Phyllotreta nemorum*) and allied species which were the cause of the mischief. Beetles were sent him for scientific investigation which had been taken from the fields, and these proved to be the Garden Chafers; but to make sure that they were the real cause of the damage, and not merely coincident with it, Mr. Atmore instituted careful investigation, and found the case was as stated.

On the 10th of October Mr. Atmore was good enough to give me the following detailed report, which I give at length as an important record of the damage caused by this beetle to a field crop which (although the chafer is known to be pretty nearly omnivorous in its feeding) has not, so far as I am aware, been previously noted as severely attacked by it.

Mr. Atmore wrote me as follows:—"In answer to your enquiry and request for information upon the alleged *Phyllopertha* attack on Turnips, I am now able to state that the attack and subsequent complete loss of Turnips upon the large acreage referred to in my correspondent's letter was caused by *Phyllopertha horticola*, and not by species of *Phyllotreta.*

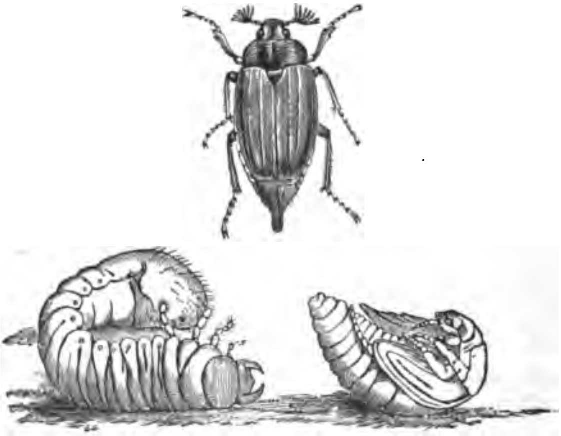
"I give here extracts from my correspondent's letter, Mr. R. C. Winearls, of West Dereham, Norfolk, who writes, June 13th, 1895:—'I am sending you to-day several specimens in a box. . . . One friend of mine who has supplied me with these specimens has had fifty acres of growing Turnip-plants entirely eaten off, and they will have to be sown again. They are equally rapacious with the leaves of Peach-trees, Apple, and even the Peas in the garden they are taking off. . . . Can you tell me their proper name? . . . Please return me three or four of these pests, and retain the rest for examination.'

"The beetles were certainly *Phyllopertha horticola*, Linn., and from subsequent enquiries made, I have been able to ascertain that the Turnip-plants were entirely eaten off in a day or two by swarms of this pest—that Turnips in the neighbourhood of Beechamwell, Marham, and Barton Bendish (Norfolk), suffered considerably from their attack. In the course of correspondence, I pointed out to my informant, Mr. Winearls, that these beetles would *not* be likely to feed *by night*, and that the damage would be done *by day;* that the beetles would be found to be sluggish at night, and many of them concealed in various ways. These remarks my correspondent found upon further investigation were correct.

"Personally I may add that I have ound *P. horticola* excessively abundant everywhere in this neighbourhood at the end of May and during June this year. During my entomological outings they would seem to have been especially partial to the foliage of Birch-trees, and from some of these trees I have seen the beetles fall like a shower of hail when the branches have been tapped with a stick or shaken."—(E. A. A.)

Where an infestation occurs, as is too frequently the case with this especial one, year by year in the same district, if growers were on the alert and ready to destroy the beetles on their very first appearance, it could not fail to make a deal of difference in amount of egg-laying, and consequently on future amount of maggots.

So far as the observations lately sent me show, there is present evil and consequent danger of recurrence of attack next year from the quantity of maggots. Miss Dobell, writing to me on the 4th of Oct. from Detmore, near Cheltenham, mentioned that the maggots were perfectly swarming on her fields just under the grass, and added, "I have just been out, and with a rake have thrown up thousands."



MELOLONTHA VULGARIS, Common Cockchafer, maggot, and pupa.

The Common Cockchafer has been so repeatedly written on, both scientifically and popularly, for almost countless years, that until some advance is made in practicable methods of getting rid of the grubs, it appears almost impossible to add any more serviceable observations.

Therefore I do not insert the various Scotch and English notes of its presence sent me during the past season; but as its larva, or grub, is to a great extent taken as the type (save in size, or some few peculiarities) of the other three kinds here mentioned, I add the description by the Rev. Canon W. W. Fowler as being serviceable for trustworthy reference:—

> "The larva of *Melolontha vulgaris*, the Common Cockchafer, has been described by many authors; it is large, thick, and fleshy, of a dirty white colour, with the head ferruginous and shining, and the legs pale ferruginous; the antennæ are a little longer than the mandibles, and are 4-jointed; the anterior pairs of legs are rather shorter than the intermediate and posterior pairs, which are of equal length; the segments are transversely rugose, and the last is large and apparently divided by a false articulation; the upper surface of the body is furnished with short upright bristles, and long separate hairs which are intermingled with these; the pupa is rather large, with the abdominal portion slightly curved, but does not present any striking peculiarities." *

The Summer Chafer, *Rhizotrogus solstitialis*, L., is about half the size of the Cockchafer, and very like it, excepting not being prolonged into a tail-like extremity, and also in being much more covered with longish fine hair. The length averages three-fifths of an inch; the general colour clayey or yellowish; the wing-cases, with the suture and outer margin, somewhat darker than the disc, which has four slightly-raised whitish lines; the legs reddish.

The larvæ, as mentioned at p. 24, are exceedingly like those of the Cockchafer.†

On July 16th some specimens of this chafer were brought me as samples that appear every year in the higher part of St. Albans, near the cemetery. The observer had not noticed them low down, but flying round the chimneys, and on the green trees.

This agrees with the description of their habits given by Dr. Taschenberg (see reference):—"In the evenings from the second half of June onwards the males swarm around the low trees over cornfields, and round the heads of foot-passengers, whilst the females rest on grass, or corn, or other plants near the ground." A few days after pairing, egg-laying begins. The white roundish eggs are laid singly in the earth, up to twenty or thirty by one female. From this frequent creeping in and out, the hair is gradually rubbed off, so that the specimens captured towards the end of the time of flight of the chafers are often bare.

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* 'British Coleoptera,' Fowler, vol. iv. p. 51.

† A minute description will be found at p. 44, part ii., of 'Praktische Insekten-Kunde,' by Dr. E. L. Taschenberg.

After three or four weeks, up to the end of July, the young larvæ come out, and feed in the same manner as Cockchafer grubs; they go down deeper for their winter sleep. Next spring they come out again, change their skins for the last time at the beginning of May, and are more voracious, and consequently more destructive, than they were previously.

About the end of the month above-named they go into chrysalis state. The chafers appear from the middle of June to the middle of July; and in German observations are stated to feed, amongst other things, on Fir-leaves, and the infestation has been noted in one district as mischievous in autumn at the roots of young Rye.

Observations of this chafer in grub state have never been sent me; but the above notes taken from Dr. Taschenberg's 'Praktische Insekten-Kunde' may be useful for reference.

In regard to methods of prevention and remedy, these have been fully entered on previously. But it may be just mentioned that with regard to getting rid of the beetles, the most practicable plan (in this country) appears to be shaking them or beating them down at whatever time of day, or in whatever kind of weather, they are most sluggish, and destroying them.

For the grubs,—if there is a possibility of turning them up to the surface from the depths they have gone down to in winter, it would be a thoroughly good treatment. Other measures, such as turning on pigs, or poultry, are more or less useful, and also taking care that the larger wild birds which follow the plough on infested land are not disturbed.

Spotted Crane Fly. *Tipula* (*Pachyrrhina*) *maculosa*, Hoffmansegg.*

The leather-jacket grubs of the Daddy Longlegs, or Crane Flies, are one of our yearly farm troubles. The common Daddy Longlegs, *Tipula oleracea*, has been so repeatedly written on for fully scores of years, that it cannot be desirable to say more about it, excepting that whilst preventive and remedial measures which would certainly lessen amount of loss from its ravages in ordinary farm service are well before the public, and only need to be acted on to do much good, yet we certainly need knowledge of treatment reasonably practicable on the wide scale required for outbreaks on marsh pastures, or mountain pastures, or other great areas of grass-land.

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* Figures of *Tipula oleracea* in all its stages will be found in Reports on injurious insects by Ed. noted further on, and in many others of the set; and figure of *T. maculosa* in Report for 1879, p. 10.

In the course of the observations sent me during 1894 regarding the ravages of the Antler Moth caterpillars in the south-west of Scotland, Mr. R. Service, of Maxwelltown, Dumfries, mentioned the great injury which was also sometimes caused on the upland pastures by the devastations of *Tipula* grubs; and in the past season specimens were sent me from Antler Moth infested pastures, which proved to be larvæ of the *Tipula maculosa*, or Spotted Crane Fly.

On the 24th of May (in the past season), Mr. W. Gray, writing from Tanlawhill, Langholm, Dumfries-shire, N.B., sent me accompanying some quite young caterpillars of the Antler Moth of various sizes, from very small, up to as much as a third or half-grown. He mentioned at the same time the injured appearance of the grass, but that on searching for the caterpillars there seemed very little sign of them, which he ascribed to their being still so small that they escaped observation.

However, about a month later, the true cause of the damage was found. At the beginning of July Mr. Gray wrote me again as follows:—"By same post as this I send you some maggots which one of the shepherds brought me, saying that he found them where the grass was worst damaged, and that they were in great numbers. As the Antler grub is *not* in very great numbers to account for the large destruction, these maggots may destroy grass also." Mr. Gray further remarked that though the Antler caterpillars were not so plentiful as in 1894, there was much more damage being done to the grass.

A liberal supply of grubs was sent me, which on careful examination proved to be larvæ of the *Tipula maculosa*, according to the description given in Curtis's 'Farm Insects,' p. 450. The maggots of the Spotted Crane Fly are distinguishable from those of the common Crane Fly, or Daddy Longlegs, by being lighter coloured, softer, and a good deal smaller. According to John Curtis's measurements, they are only three-quarters of an inch long, and about as thick as a large crow-quill, whereas the larger kind are about an inch long, and as thick as a goose-quill; but independently of size when full-grown, the two kinds differ in the shape and arrangement of the four tubercles at the upper edge of their truncated tail extremity.

In the grubs of the common Crane Fly (*T. oleracea*) there are four fleshy tubercles, more or less pointed; but in the Spotted Crane Fly the truncated tail terminates above in two spreading hooks, with two short teeth between them: this peculiarity was very noticeable in the specimens sent me. Besides these, in both kinds of grubs there are two spiracles in the middle of the truncated end of the tail, and two tubercles below; and John Curtis notes, in the case of the Spotted Crane Fly, that there are two fleshy protuberances, which can be dilated or contracted at pleasure, and help the maggots in locomotion. The grubs, like those of the common Daddy Longlegs, are cylindrical and footless; their small *brown* heads are retractile into the fleshy body, and furnished with a pair of minute black jaws.

In spring they change to the pupal state, in which, like the common Crane Fly (the *Tipula oleracea,* of which figures have been frequently given in these Reports), they stand upright in the ground, with about half of the body exposed, showing the cases above the folded-down wings, and also above the legs, lying centrally between them.

The flies are about half an inch long, with an expanse of wing of about one inch. The colour a very pretty yellow, much spotted with black. The male has eight black spots along the top of the abdomen, the female six, with (in each case) other black spots or dots below. "The wings are smoky yellow and iridescent, with brown nervures, a yellow pinion edge, and stigma; the poisers ochreous, and the legs mostly ochreous, with black feet." *

These yellow black-spotted Crane Flies may be found in May, June, and July, but whether the successive appearances are from successive broods, or difference in date of laying, appears uncertain.

For the most part the reports sent in as to *Tipula* maggot ravage make no distinction between the kinds of grubs that may be present, but now and then a trustworthy observation shows the great damage caused by this special kind, as in 1879, when Mr. E. A. Fitch, F.E.S., reported them to me as being very injurious in a nine-acre field of his at Maldon, Essex,—to Wheat after Red Clover. In April he had the Charlock (*Sinapis arvensis*) pulled, and the soil, being wet and tenacious, adhered to the fibrous roots, "and the quantities of small *Tipulæ* larvæ exposed were enormous."

John Curtis mentions that from the immense swarms of the gnats of this species on lighter arable land he inclined to think that the corn-crops suffered more in such situations from this than from the common larger kind. Also it is to be found on damp or marshy grassland. Dr. Ritzema Bos (see *loc. cit.*) notes having himself observed it in enormously large amount on the Nordpolder, in the province of

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* Detailed description of this species of *Tipula* in its different stages, with figures accompanying, will be found in the volume of the 'Gardeners' Chronicle' for 1846, p. 317; and descriptions, with much useful information regarding them, in 'Farm Insects,' pp. 449–451; in both cases by John Curtis. The most recent account I am acquainted with is an excellent one given by Dr. J. Ritzema Bos (from his personal observations) in his 'Tierische Schädlinge und Nützlinge,' pp. 595, 596. Berlin, 1891.

Groningen. The precise definition of "polder" is "marshy ground" dried by cutting canals and ditches, and the description of the province of Groningen, in Johnston's 'Dictionary of Geography,' p. 588, is, "Surface flat, low, and partly exposed to the inundations of the sea. It is rich in pasturage, but marshy in the S.E., where it is bounded by the morass of Bourtang." If we add to the light and sandy arable land, the above low-lying marsh grass-land, and the upland pastures of the S. of Scotland, besides a sort of general ravage, such as feeding at the roots of Clover and Peas, eating off the crowns of Strawberries, and damage at roots of other kinds of garden and field crops too numerous to specify, it certainly appears that this pretty yellow black-spotted kind is hardly behind the common larger grey kind in its injurious powers.

The remedies and means of prevention for both kinds are alike, and have already been given.* In these notes are given of methods of prevention of egg-laying, or of treatment of infested grass-land, including paring and burning (an excellent plan where it can be carried out at a paying cost), hand-picking, feeding stock on the ground, and cutting grass so that there should be no shelter for the flies, and the eggs and young grubs should be poisoned, and draining, as a matter of course, to put an end to the dampness and consequent coarse growth of sheltering herbage in which the flies delight; notes of stimulating applications found serviceable to drive on good sound growth, and thus save moderately injured young corn or other crop, including in these nitrate of soda, which is doubly helpful by disagreeing with the grubs, as well as encouraging growth; notes of birds found to do good by clearing the grubs, and of mechanical measures useful in throwing them open to the birds, or of so firming the soil by rolling as to prevent the grubs travelling. These and many other points are given in detail, but amongst them all is one important habit of the grubs which appears much more certain now than in the earlier observations. *This is the extent to which the grubs come up in the evening to feed on the surface of the ground.*

One of the first observations of the grubs coming in great numbers on the surface was sent me in 1880, by Mr. Whitton, from Coltness, Lanarkshire, N.B., where there was such a strong attack of *T. oleracea* larvæ that he noted he had never seen anything like it before for quantity. The grubs were noticed in moving plants in the garden, "and as many as possible were killed with the spades; the beds were left for a day or two, and then forked over lightly again. . . . *In the*

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* See my 'Annual Reports' for the years 1879, 1880, 1884 (in which the subject of *Tipulæ* is entered on in much detail, pp. 19–28); 1892; and short mention in various other of my 'Annual Reports,' with figs. of the *T. oleracea*; and in that for 1879 of the *T. maculosa* also.

morning the grubs were on the walks by hundreds," and there, of course, they were easily dealt with.

In February, 1884, Mr. Berry Torr favoured me by having special observations taken at Westleigh, near Bideford, when bad grub-attack was going on; *and the grubs were found on the surface in large numbers at about one o'clock in the middle of the night.*

In 1892 I had observations from a locality in Shropshire, on the 2nd of June, of the grubs doing much mischief to a field of Turnips, and "being observed to burrow lightly under the soil during the day, *but at night to come up and crawl on the surface.*"

Also many years ago it was matter of observation of my late brother, the Rev. John A. Ormerod, Bursar of Brasenose College, Oxford (who both officially and as an observant naturalist was accustomed to noting the habits of agricultural pests), that Daddy Longlegs grubs came out in such great numbers by night from the grass in the College Quadrangle that in the morning it was a regular thing to clear the quantities on the walks by sweeping them up.

In the above observations only the presence of the grubs above ground is mentioned, but in the following note by Dr. Ritzema Bos, of his own personal observations of the grubs of the *T. maculosa* (the Spotted Crane Fly), it will be seen that he not only observed them above ground in the evening and by day in the dark damp weather, but was also able to watch them at work at the growing field crop. Dr. Ritzema Bos, after recording some special experiments, observed: "On the fields I saw the grey larvæ in the evenings (and in dark moist weather also in the day) leave the earth and feed above ground; still the underground ravage was of much the most consequence." *

In the coming season some more observations of the extent to which *Tipulæ* grubs come out to feed at night would be very desirable. It is not reasonably possible to roll in the middle of a February night, however mild the weather may be; but at a better time of year, in cases where great breadths of marsh pasture were being ruined by Crane Fly grubs, it would be well worth while to see if they were up in the evening or at night, or in damp weather by day, and if so, to try the effect of a Crosskill's roller, or a Cambridge or ring-roller. Hitherto we have not, I believe, found any remedy for infestation of large areas of marsh pasture, but if rolling could be brought to bear when the grubs were above ground the expense of the rolling would be better than the loss of the grass.

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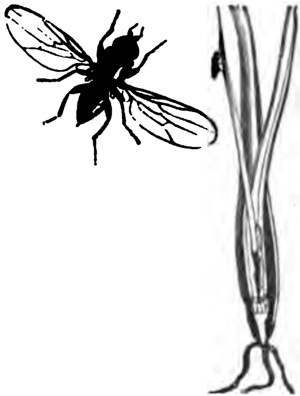
* Work by Dr. J. Ritzema Bos, previously cited, p. 595.

Frit Fly. *Oscinis frit*, L.



OSCINIS FRIT.—Fly, much magnified; Oat-plant, with maggot within, and fly on leaf-blade, natural size.

Frit Fly is probably always more or less present here, and if the signs of the attack were better known so that treatment could be given before the young Oat-plants were injured past all hope of recovery by the gnawings of the maggot within them, much good would be done. As it is, the young crop withering, or the growth failing towards the middle or end of June, is commonly what draws attention to mischief being present; and by the time that samples have been sent by the grower for information as to what is amiss, and the remedy has been learnt, and the requisite application has been procured, the time has most likely gone by in which treatment might have saved the crop.

In this country the Frit Fly attack may be said to be scarcely half as injurious as it is in various parts of continental Europe, for it rarely is reported with us as injuring the ears or seed-heads, nor does it appear to extend its attacks to Barley, on which it occurs as well as Oats in various European countries, as France, Germany, and Bohemia, and to an especially mischievous extent in Sweden.

The fly is two-winged, bright shiny black, and of the shape and size figured above, respectively, nat. size and mag.; and though now and then mischief is done by the maggots of the second brood feeding in the Oat-heads, the chief damage here is from it as an infestation to the young growing Oat-plants.

The maggot feeds in the heart of the young plant. It is only about the eighth of an inch long, whitish, legless, cylindrical, with a strong pair of curved mouth-hooks in the bluntly pointed head end; and when much magnified will be seen to have a *branched* spiracle, or air-tube, projecting on each side near the head; and also two wart-like projecting spiracles at the blunt tail.

The chrysalis is rather smaller than the maggot, reddish-brown in colour, more pointed at the head than at the tail extremity, which latter appears from the size of the wart-like spiracles, which it bore in maggot state, to be strongly cleft. The branched external spiracles, or "air-tubes," near the head, are also for a time clearly noticeable. The maggots turn to chrysalids in the dying remains of the outside leafage of the plants in which they have fed, and from these (in the most specially recorded notes which I took) Frit Flies were appearing about the 9th of July.

Weather influences may be said to have very great effect on this attack, as it has been found that late-sown Oats suffer very much more from it than those put in earlier; consequently if from prolonged cold or rain in late winter, or early spring (as well as from other causes), the Oat-sowing is delayed, the crop is likely to suffer conformably.

The following notes, sent me in 1888 (*the* great Frit Fly year) by Mr. W. McCracken, Professor of Agriculture at the Royal Agricultural College, give definite valuable observation on this point.

Writing to me from the College on the 4th of July, Prof. McCracken observed:—"I send you a few specimens of Oat affected by a small grub [that of the Frit Fly, Ed.]. I am sorry to say a very large area in this part of the country has suffered similarly. The crop from which these specimens are taken is practically destroyed, except for hay. *Winter Oats and all early spring-sown fields seem to have escaped.*" * A few days later, examination of one of the badly attacked fields alluded to showed damage roughly estimated by Prof. McCracken as 90 per cent. of crop gone.

In 1889, Prof. McCracken wrote me again, from the Royal Agricultural College, on the same subject at the beginning of August:—"The Frit Fly has again been the most plentiful of injurious insects, and, as was the case last year, *the degree of injury corresponds to the date of sowing*. For example: in one field Black Tartarian Oats (the sort most largely grown here) were sown on March 29th, and enjoyed almost complete immunity from attack; in another field, sown on April 29th, over seventy per cent. of the first stems were destroyed."

The following note, sent on the 17th of June in the past season from Ossemsley Manor Farm, Lymington, Hants, by Mr. D. D. Gibb, shows bad attack following on late sowing, and also the additional evil of unfavourable weather for growth accompanying the attack, and preventing the injured plants doing something towards returning a crop by tillering. This (as it is unnecessary to say), both from inferiority of yield and unevenness of time of ripening, is very inferior to a regularly grown crop; but still some moderate return may thus be secured, if the nature of the mischief is known in time for good dressings to be applied which (weather permitting) will push on the side-shoots at once.

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* I add italics to the above and the following passage to draw attention to the point of *early sowing*.—Ed.

Mr. Gibb wrote as follows:—"I enclose a few Oat-plants taken from a field somewhat late sown that has suffered much from attacks of Wireworm and Frit Fly; in some parts the plants have been nearly cleared. The weather is still against the plants remaining being able to tiller out and fill up empty spaces, while these pests still attack and destroy the tender shoots that are sent forth from the sides."

On June 6th Mr. P. H. Foulkes, writing to me, with specimens of Frit Fly accompanying, from the University Extension College, Reading, observed:—"In the attack of Frit Fly which I mentioned, and about which I was consulted, I recommended a dressing of nitrate of soda, and this has already done good. In one part of the field soot had been applied as a top dressing, and this was left undressed with nitrate; although this part is free from weeds as compared with the nitrate-dressed portion, yet the latter portion looks much the better, and is picking up wonderfully after the attack."

Mr. Foulkes also observed:—"Last year a portion of the field was sown with Mustard, and ploughed in; in this portion of the field the Oats have been attacked to a greater extent than in the other portion, which was free from Mustard last year."—(P. H. F.) This is sent by the observer merely as an isolated record, but which may prove of interest.

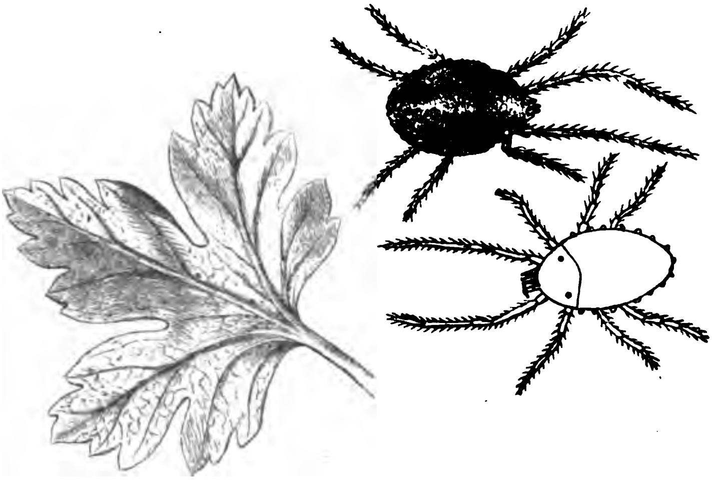
The above remarks on some of the Frit Fly appearances of the past season are given just to show that where this attack is known by sight it is still present, and probably if it were better known, so that the method of failing of the attacked plants was distinguished from what is owing to other causes, much harm would be spared.

The sign of the infestation being regularly established is much of the young plant appearing to be dying towards the end of May; but if watch was kept, especially in the southerly and south-westerly counties, earlier in the month, and on the first signs of damage the cause was looked for, we could then, by the presence of the small maggot inside the shoot, distinguish this attack, and, instead of rolling as for Wireworm, or applying remedies which are no use in this case, give right treatment at once.

This consists in application of such stimulants as will best push on growth, so that all the plants which are not touched may fill up the blanks, and tillering may do all it can in good time; and it should also be noted that in cases where the plant is so destroyed that it has to be ploughed in, that, so far as is possible, it should be thoroughly buried down. The flies come out of the chrysalids very soon, towards the middle of July; and if the infestation could be buried down altogether, by ploughing with a skim-coulter attached, or any way which put it well below the surface, much risk of recurrence would be saved.

GOOSEBERRY.

Gooseberry Red Spider. *Bryobia prætiosa*, C. L. Koch; also *Bryobia ribis*, n. sp. of Dr. Fr. Thomas.



BRYOBIA PRÆTIOSA, from life; B. SPECIOSA (outline figure after Koch): both magnified. Leaf infested by Red Spider, nat. size.

Notwithstanding the unusually severe and long continuance of cold in the early part of the year, the Gooseberry Red Spider, which was the cause of great loss to growers in the spring and early summer of 1893, and also of 1894, reappeared in the middle of March and early part of April in the past season of 1895 to an amount which caused serious anxiety as to the extent of injury that might again be coming on.

The infestation, however, which appeared in such quantities with the hot bright days, disappeared again (in the localities reported to me) during the occurrence of cold and wet; and afterwards, though there was much damage on grounds where the dressings which have been found to answer were *not* applied, the damage (so far as reported) was neither so widely spread nor so serious as in the two previous seasons. The infestation is chiefly noticed again now to record, firstly, the unusual severity of cold having *no* effect in preventing reappearance of the attack; secondly, the effect of weather in promoting or lessening the presence of the pest when once established in active state on the bushes; and thirdly, the identification by Dr. Friedrich Thomas, of Ohrdruf (the well-known phytopathologist), of specimens of Red Spider sent to him from Mr. Nixon's grounds at Great Eversden, near Cambridge, as being of a species hitherto undescribed, and which has been named by Dr. F. Thomas as *Bryobia ribis*. Thus from the minute investigations of two skilled experts it appears that we have *two kinds* of Red Spider on our Gooseberry-bushes.

As both kinds appear so like one another to general observation, and also very similar to each other in habits, the difference of species appears unimportant practically, but as a scientific point it requires mention.

On the 22nd of February Mr. F. Nixon, writing from Great Eversden, near Cambridge, mentioned:—"I am keeping a careful watch on my Gooseberry-bushes, but as yet I am able to detect nothing wrong"; and still on the 9th of March, so far as could be seen, there were no signs of the Red Spider being present.

This state of things, however, did not continue, for on the 15th of March Mr. Nixon sent me specimens of infested sprays, with the observation that he greatly feared there was every indication of another virulent attack of the Gooseberry Red Spider pest. "Last Monday, March 11th" (Mr. Nixon noted), "I was able to find one here and there. To-day I can find hundreds. Some of the buds (which are not yet open) are at the base almost surrounded by them. They appear to be just now hatching out. I shall syringe my bushes with 'Antipest' as soon as possible."

The following notes, sent me on April 8th by Mr. Walter Frost, Fruit-salesman, Covent Garden Market, are valuable as showing the great degree to which amount of attack of the Red Spider is influenced by heat, or, on the other side, by cold and wet weather. Mr. W. Frost wrote:—"I found about a fortnight ago, when we had two or three hot days, that my Gooseberry-bushes seemed almost covered with Red Spider, and at once provided myself with the wash. But the bud then was so tender that I hesitated to use it, and since the wet colder weather of the last fortnight the pest seems to have disappeared, I am afraid only to come again with sunshine. Of course, now the leaf is getting strong, and I shall wash if necessary. I hear greatly the same report from Kent. Is it possible that the Spiders, developing before the leaf, have been killed by cold and wet? I hope so."

At the same date as the above, namely, the 8th of April, Mr. F. Nixon, of Great Eversden, writing with reference to his letter of the

15th of March, gave the same account of great appearance followed by disappearance. He observed:—"At that time I was receiving grievous letters of complaint. One I had from Mr. Granger, of Ely (a large grower and jam manufacturer), in which he says, 'My Gooseberry-buds are quite red with the Spider'; and others of a similar nature. . . . Since then we have had showery weather, and I am pleased to say that quite three-fourths of Spiders have disappeared. Whether it may be that they have only gone down into the soil to reappear at a more favourable season, I am unable to say; but the fact remains that at the present moment there are many bushes on which I can find *none*, and where I can find them they are in the *centre* of the bush *nearest* to the ground. There are positively *none* on the outside branches."

A few other observations were sent me, but nothing like the report of damage sent in the two previous years; and nothing was added to methods of prevention and remedy, excepting still further proof of the absolute necessity of applying such of these as we know act reliably on the *very first appearance* of Red Spider in late winter or early spring.

On the 29th of April Mr. Nixon (before mentioned, who has observed and reported this attack to me regularly from its first bad outburst in 1893) mentioned, in sending me some specimens I had asked for, that these were not from his own grounds, as he was glad to say he had positively none; he had finished syringing for the second time about three weeks before, and since then he had scarcely been able to find a single live Spider, and to find one at all required looking over many bushes. "My bushes are practically cleared; it is the best result I have ever attained, and I attribute it solely to the fact of my commencing to syringe *as early as possible when the Spiders were only just hatched, and no foliage to shelter them.*"—(F. N.)

Quite absolute certainty as to what distinct species of the Gooseberry Red Spider (scientifically, *Bryobia*) may be present, is a point which none but skilled experts can decide; and resting on this we appear to have two species present, one of these being, as mentioned in my two preceding Reports, the *B. prætiosa*, of C. L. Koch, as kindly identified for me by the skilled determination of Mr. Albert Michael, F.L.S.* The other proves, from the investigation of Dr. F. Thomas, of Ohrdruf, during 1894 and 1895, to be a species hitherto undescribed, which he has named *B. ribis*. For those who wish to go into the subject fully in minute detail, with the points of distinction between the above and various other species, the information will be found in the paper mentioned below.†

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* See my 'Seventeenth Report on Injurious Insects,' page 33.

† 'Die rote Stachelbeer Milbe, *Bryobia nobilis*, C. L. Koch (?), ein in Deutschland bisher nicht beachter Schädiger des Stachelbeerstrauches,' von Prof. Dr. F. Thomas in Ohrdruf (aus Wittmack's 'Gartenflora,' 43. Jahrgang, 1894).

But looking at some of the points, which can be seen with the help of a moderate magnifier, and are serviceable to know for practical work, a very important one is that the Gooseberry Red Spiders, that is, the species of *Bryobia*, are clearly distinguishable, by their foremost pair of legs being *much longer* than the others, from the Hop Red Spider, *Tetranychus telarius.* The life-history is that they are hatched from eggs, and at first have only three pairs of legs; with increase of age they develop another pair, so that in adult state they are eight-legged (see figure, p. 40). The colour in the specimens sent me was brick-red of various shades, from bright to ordinary brick colour, and in some instances I have found them of a vermilion colour along the back of the abdomen, and much darker at the sides. The length was about the thirty-second part of an inch, that is, about a quarter of an eighth of an inch.

So far as I am aware, our infestation (so to call it) resembles in all points of its life-history and means of prevention of its ravages the species, very fully described with all points considered, in the paper on the 'Red Gooseberry Mite' ('Die rote Stachelbeer Milbe') previously cited, and here also the points of distinction between the above species of *Bryobia* and other very similar kinds, turning much on numbers of pairs of scales (Schuppen) on the back or elsewhere, will be found at pp. 493—495.

But for practical purposes for ordinary observers the following short report given by Dr. F. Thomas at Mülhausen, in Thuringia, later on in 1894, will be found to contain plain and useful information.* In this Dr. Thomas spoke on the injury to Gooseberry-bushes caused by *B. ribis*, n. sp., a small red-brown mite of about two-thirds of a millimetre in the length of the body, and demonstrated the extent of these injuries by specimens which he had taken just before the meeting from a garden in Mülhausen. These specimens had become whitish on the upper side from the suction of the mites, and the small remaining leaves had not power to provide a sufficiency of nourishment; the fruit dropped prematurely, and so did the leaves in autumn.

"The mites live from March and April until the beginning or middle of June, and in the early part of the spring may be successfully combated by plentiful sprinklings of the Gooseberry-bushes with water, or occasionally with weak soap-wash.

"In May and June the mites lay small shining red eggs, which are plainly observable, with the help of a weak magnifying-glass, on the twigs, and especially on, and between, the remains of the old bud-scales. These eggs remain unchanged during the remainder of the year, and it is not until the following spring that the young mites escape from them. With regard to methods of prevention by killing the eggs, no information has been brought forward.

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* 'Aus dem Sitzungs-Bericht, der Frühjahrs Hauptversammlung 1894 (zu Mülhausen, in Thüringen). Sonderabdruck aus Mittheilungen des Thür. Bot. Vereins,' Neue Folge, Heft vi. 1894, Seite 10 u. 11. For both his detailed paper and this leaflet I am indebted to the kind courtesy of Dr. F. Thomas.—Ed.

"Of the hitherto described species of *Bryobia*, the Gooseberry Mite, the *B. nobilis* of C. L. Koch, comes the nearest; however, according to Koch's drawing and description, characteristic differences are present which clearly permit venturing identification of two species.

"As hitherto no notice has been given of this increasing, and in dry years very dangerous, enemy of Gooseberry-growing, in German serials, or books of instruction, or in statements in known literature, the report in Wittmack's 'Gartenflora' of the year 1894, containing a fully detailed communication on the subject with figure accompanying, was published."—(F. T.) * To this Dr. Thomas adds a few lines relatively to my having contemporaneously brought forward in my own Annual Report considerations regarding the injurious infestation of Gooseberry Red Spider in England.

As the matter stands at present, it appears to me that we have two, and possibly more kinds of what, for all practical purposes, it is enough for us to know as Red Spider on Gooseberry-bushes, and that these kinds are so similar in their habits, that they lie under the same means of preventive treatment.

Of the applications most serviceable for this purpose, all observations (that I am acquainted with) agree in stating that washings with a basis of soft-soap are most useful. The "Kerosine Emulsion," so much thought of in the U.S.A. (especially if used warm), is an excellent application, and what may be called its "British representative," the "Anti-pest," manufactured by Messrs. Morris, Little & Son, of Doncaster, is very widely used, and with great success, and is to be recommended for use by all those who have not acquired the difficult knack to master, of so blending the soap and mineral oil of the Kerosine Emulsion that they shall not again separate. I also believe that a composition with a basis of soft-soap, brought out by Messrs. Stott under the trade-name of "Kill'mright," has been found serviceable.

Dry dressings, such as soot, or slacked lime, have been reported to me as useless, as also application of paraffin oil much diluted, but without soap added.

Where very plentiful washings with water alone can be given, these are serviceable, because, as pointed out in Dr. Friedrich Thomas's paper before referred to, this partly stupefies the mites,—causes a lethargic condition from which, if soon dried, they recover, but in which, if continued for some days, they waste.

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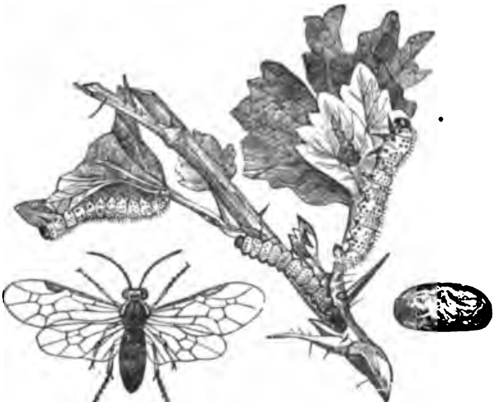
* See paper by Dr. Thomas, from whose short leaflet on the same subject I have translated the above, of which the title is previously given.

The fact of the eggs being found in the crannies of rough bark during winter, and of the mites similarly sheltering during the season of their fully-developed presence, points directly to the advantage of scraping off and getting rid of rough bark as far as can be managed, and also of removing gnarled and rough-barked boughs; also, and very particularly, of syringing and running soft-soap washes down the stems so as to fill the crannies and angles of the branches, and thus choke up the lurking-places, and stifle the mites within them.

To the above should be added a note of the vital importance, if the infestation is to be got rid of, of commencing remedial operations *as soon as ever* it appears in the spring. If a little keg of whatever mixture the owner prefers is kept at hand on grounds where there is reason to suppose the attack may appear, then at the *first signs* (it may even be as early as the middle of February) the remedy can be applied forthwith, and it may be hoped a cure made. But if instead advice has to be sought, and the application to be written for, days are lost, in which the injurious pest is hatching out by hundreds or thousands, and not only doing present mischief, but establishing itself to lay the foundation of further presence.

Gooseberry and **Currant Sawfly.** *Nematus ribesii*, Curtis.



NEMATUS RIBESII.—Male Sawfly, caterpillars, and cocoon, all much magnified. After figures in Reports of Ent. Soc. of Ontario. Dimensions given in letterpress.

Gooseberry Sawfly needs some reference again for several reasons, one of these being the great amount, and also the destructive nature of its attacks in various places, notwithstanding the severe cold of the latter part of the winter. With some of our injurious insects it may be difficult to be certain whether or not especially great cold reached them; but, in the case of the Gooseberry Sawfly, the position of their winter caterpillar-cocoons, just below the surface, gives a very fair example of non-injury from severe cold so long as the creatures are in their own self-arranged shelters.

Often also there is such difference in temperature at different localities that it is difficult to make sure of coincidence of special conditions of weather and of insect presence. But last winter the severe cold was general, and without going into readings of earth temperatures at different depths below the surface, we get good practical guidance to the long frost-bound state of the ground in the returns of various of the leading agricultural papers at the end of February and beginning of March as to the land in the various wide districts named being only then beginning to get into order for ploughing.

Also, in the past season's reports, we have mention of success of some good broadscale remedial applications, and, on the contrary, of failure of treatment, for which possibly there might be a cause.

Also, from enquiry sent to myself, some further allusion seems requisite to the change that takes place in the appearance of the caterpillars at their last moult. This is not as great as in the case of the Pear-tree Sawfly, in which the black, slimy, slug-like grub, on casting its skin, appears as a dry orange-coloured caterpillar; but with the Gooseberry caterpillar, the casting of the green and yellow black-spotted skin, and assuming one of unspotted green and yellow, gives such a different appearance to the grub as sometimes to cause doubt how many kinds are present.

One of the first reports of bad amount of presence of Gooseberry Sawfly caterpillars was sent me from Stratford-on-Avon, on May 10th, by Mr. Wilson, as follows:—"I have a plantation of Gooseberry-bushes, and last year they were very badly infested with caterpillar. I had two men on for a fortnight hand-picking them, but could not keep them under, and most of the bushes were stripped. I was through them this morning, and am sorry to say I found quite a number of the insects all through the plants, but as yet there is no serious damage done, and as the attack is much earlier this year than last, I hope to be able to clear them by spraying."

On the 18th of May Mr. Wilson further noted that the caterpillars had made great havoc since the date of his first letter, and that he was then starting hand-picking.

The following report of presence of Sawfly was sent me on the 15th of May by Mr. Edwin Ellis, from Summersbury, Shalford, near Guildford. This, it will be seen, notes devastating amount of attack on the large area of sixty acres of Gooseberry-bushes, this following on slight presence late in the previous year, after nine years' previously observed immunity from attack; also the failure of remedial measures:—"I have sixty acres of Gooseberries attacked by the Sawfly caterpillars, from which they have for nine years been perfectly free, with the exception of last year, when a few appeared in September after the crop was picked.

"The ravages committed within the past three days are perfectly astounding, despite the fact that every available hand has been put on spraying with quassia and soft-soap, while others follow and spread slacked quick-lime on the creatures as they lie under the trees. We are picking the fruit as fast as possible where we have *not* used the spray; but with such a big ground there appears little hope of stopping the mischief."

Mr. Ellis further enquired whether there were any means by which the pest could be got rid of for the future, as it was ruinous if continued, and he could hardly hope that all would be exterminated by any system whatever. This matter I refer to further on.

On the 24th of May Mr. Eldred Walker, writing from White Hall Farm, Chewstoke, near Bristol, gave me the following recipe for a good broadscale application which he had found useful in clearing this destructive pest:—"It may be of interest to you to know how I have exterminated the Gooseberry Sawfly and Red Spider from my garden. For several years my Gooseberries were completely spoiled by these pests. I made a couple of hogsheads of strong lime-water, and thoroughly sprayed the bushes with it *early in the morning.** I had an assistant to pull the bushes over, so that the liquid might reach the under part of the leaves as well as the outside. After about five minutes of this, I had the bushes violently shaken, when nearly every insect dropped off; to complete their discomfiture, directly I had done shaking the bush, I had the surface of the ground freely dusted with air-slaked lime. I had this done three times at intervals of two days, and now I have not the slightest trace of the ravages of either in my garden. I find this treatment is far better in the early morning than when it is used at mid-day."—(E. W.)

The following observation, sent me on the 10th of July by Mr. Geo. Whereat, from Aldington Grove, Sydenham, shows continuance of bad attack late in the season, and in this case notes it also as infesting the Currant-leafage:—"I am suffering from a regular epidemic of caterpillars on the Gooseberry-bushes. . . . These are eating every leaf off the bushes. I have tried soft-soap and paraffin, which they seem to thrive on, also salt water; hand-picking seems useless, as there are frequently four or five on each leaf,—I found seventeen on one Currant-leaf. They are very pale transparent green, with tiny black spots, a yellow band at head and tail, varying in size from about a quarter-inch to an inch in length."

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* I add the italics, as this is a very important point.—Ed.

Various other communications were sent me, unnecessary to enter on at length, including information on the 21st of May of great numbers of Gooseberry Sawfly caterpillars being observed near Crocken Hill, Swanley, Kent; and on the same day it was reported from Billinghurst, Sussex, that they were "fearfully troubled by the Gooseberry caterpillar in that district."

LONDON-PURPLE as an insecticide.—The following detailed notes of method of (and also success of) application of London-purple for getting rid of the Sawfly caterpillars are well worth attention, not only as a cheap and simple method of getting rid of this special pest, but also because, if properly used, it is as serviceable for use as an insecticide as the better known Paris-green. Both of the chemicals are poisonous. The Paris-green is an *aceto*-arsenite of copper, the London-purple is an arsenite of lime; both therefore require care in use, as has been specified before.

The great difficulty in the first use of London-purple was that in the U.S.A. (from whence, as well as in the case of Paris-green, we first learnt its value) it was thrown out as a waste product of such various strength that nothing but special trial of extent to which it might need diluting made its use safe. Here, however, we can procure analysis which saves successive trials. I have at this minute that of Messrs. Hemingway, of Mark Lane, London, E.C., before me.

The following note was sent me on May 10th by Mr. F. Nixon, from Great Eversden, near Cambridge:—"With regard to the London-purple, I have used it for the last five to six years, and at the outset made sad havoc amongst my trees and foliage, in fact I killed numbers of trees by giving too strong an application. I am wiser now, and have found out the proper proportions in which to mix it. Nothing appears to me so good, cheap, or easy of application. I use Hemingway's, and mix in the proportions of 1 lb. of purple to 200 gallons of water. The purple itself should be mixed to the consistency of paste before finally mixing with the bulk of water, and this bulk must be well stirred *every time* the spraying-machine is filled, otherwise the purple will be all at the bottom, and the water at the top, the effect of which is that in some places the caterpillars are not killed, and in others the foliage is scorched (I am speaking of Gooseberry-bushes).

"Our No. 86 spraying-machine (the one I am interested in), manufactured by Messrs. Boulton & Paul, of Norwich, is an excellent implement for spraying this insecticide for the reasons that for this purpose I have a return-pipe attached to the pump, so that a strong jet of the mixture is continually forced through the bulk which the tank of machine contains, thus keeping the whole, as it were, boiling and well mixed up.

"The caterpillars *are not killed the same day* the application is made.

The day after some will be found dead; the second day, a good number; and the third day, as a rule, the bushes will be cleared. Many people make a grave error here. They expect the insects to be killed in a few hours after the application, forgetting that they must have time to eat the poisoned foliage, and that it must have time to do its work. Consequently they will apply a stronger mixture, which is certain to scorch the foliage, and thus they complain that purple can only be effective at such a strength as will likewise burn the foliage. This is entirely wrong, for after years of experience I can confidently guarantee that, mixed and used in the proportions and way I have named, London-purple will kill almost every caterpillar that may be present. I am proving this every day in my own orchards."—(F. N.)

To the above, Mr. Nixon added that he sent me a few Gooseberry-leaves with the caterpillars on them, as he wished me to see exactly how they died. These had been syringed with London-purple in the way described above at noon on the previous day (that is, just twenty-four hours from time of writing). Mr. Nixon noted that they were not quite dead when he put them into the box, but supposed they would be when they reached me, which proved to be the case; all the specimens—that is, the caterpillars of the Gooseberry Sawfly—were dead when I received them on the following day.

The Gooseberry Sawfly caterpillars, when full-grown, are about an inch in length; the ground colour green or pale-green; the segment next to the head and a little of the next one orange-coloured; so also are the tail segments, but with such a large black mark above, with smaller dots at the side, that the tail is sometimes described as black. They are furnished with a pair of black claw-feet on each of the three segments next the head; the next segment is legless; and on the succeeding six segments is a pair of pale-coloured sucker-feet, and there is another pair beneath the tail, making twenty pairs in all. The caterpillar is sprinkled with dots, or patches of black, until its last moult, when these are thrown off with the skin, and the caterpillar becomes of a pale-green, but still orange behind the head and on the tail.

Shortly after this last moult they go down to the ground and bury themselves, and spin their cocoons, about two inches deep, or more, according to the nature of the soil, and in these they turn to chrysalids.

The Sawflies come out from these cocoons in about three weeks in summer; the late broods of caterpillars remain in cocoon during winter, and the fly comes out in the following spring at the time of the Gooseberry- and Currant-bushes coming into leafage. The Sawflies are of the shape figured at page 45, with four transparent wings. The head and body between the wings are yellow or ochrey, marked with black; abdomen yellow or orange, more or less marked above with black. The expanse of wings half to two thirds of an inch.

PREVENTION AND REMEDY.—The fact of the cocoons, from which the Sawflies come out, being formed *in the ground, just below the surface, beneath the bushes*, on which the caterpillars fed, is the basis of all reliable methods of prevention of recurrence of attack.

It is obvious that if the surface of the ground containing these cocoons is skimmed off and destroyed, this cannot fail to lessen the amount of Sawflies which would have hatched from them. But for this, it is necessary that the cocoons should be destroyed, and if they are skimmed off this can be done; but digging them in is an exceedingly doubtful preventive.

It is a practice sometimes to scrape the surface-earth from beneath the Gooseberry-bushes in the autumn, and to form it in a line between the rows, and there dig it in, and doubtless some amount of attack is got rid of in this way; but for the plan to be at all trustworthy, the earth should be *trenched* in, so that the infested earth should be put thoroughly down at a depth from which the Sawflies (if they developed at all) could not come up in spring.

Sometimes, however, the scraped-off earth is left (as I have seen it myself) lying in lines between the Gooseberry-bushes without anything further being done to it, and the result was, as might have been expected, the cocoons lay uninjured through the winter, and as the grounds were large, the mischief that followed in spring was to a serious extent.

At a time when I had attack in my own garden, I found that it answered to completely remove the soil for a few inches deep in autumn from beneath the infested bushes, and dress with manure; and the following note, sent me some years ago by Mr. Alex. Anderson, from The Gardens, Oxenford Castle, Dalkeith, N.B., is well worth attention:—"For twenty years Gooseberry Sawfly caterpillars have not occurred in the gardens under treatment in any quantity. The surface-soil under the bushes is annually removed in winter, a deep hole is dug in one of the quarters, and in this the removed soil, with *whatever may be in it*, is buried. The soil under the Gooseberry-bushes is replaced by that out of the hole, with the addition of some manure." —(A. A.)

The above is only one of various reports given by superintendent gardeners as to the thorough success of *removal* of the infestation bodily.

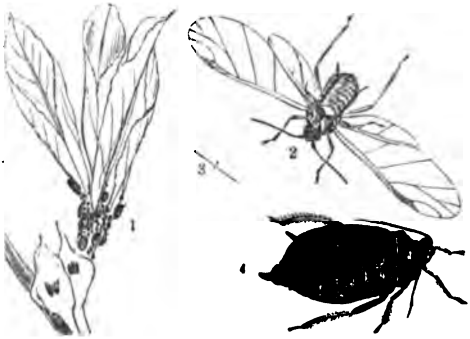
As a lesser measure, dressing with lime, or, better still, with gas-lime, in early spring under the bushes before pricking the surface, has been found very beneficial. The sprinkling of gas-lime must of course be given with caution as to amount.

For dressings to the leaves when attack is present, sulphur, *dusted on the leaves when the dew is on*, has been found to act well; also a liberal sprinkling of soot *early in the morning when the leaves are damp* has answered well. Hellebore powder is a good remedy so far as clearing the caterpillars is concerned, but being a poison should only be used by those who can be absolutely sure there is no risk of the powder remaining on the berries when gathered for use. Hot lime also, dusted on the leaves, does good; and other ordinary insecticides, wet and dry, which have previously been specified, and which will occur, indeed, without specification to all fruit-growers.

But, from the numerous letters sent me in the past season, there appear to be a few leading points in prevention and remedy that need to be much more attended to. *Clearing the cocoons out bodily* from under infested bushes is of the greatest importance; also that powder dressings should be thrown so as *to adhere*, that is, when the leafage is damp; and also sufficient attention is not paid to the lime being *used hot.*

MANGOLDS.

Black Aphis; Collier. *Aphis rumicis*, Linn.



Aphis rumicis.—1, infested Bean-shoot; 2 and 3, male, nat. size and magnified; 4, female.

In the earlier days of Mangold-growing in this country, this crop was considered to be remarkable for its freedom from insect attacks. Whether this was the case, or whether it was simply that the infestations were not observed, is doubtful, but during the past few years several infestations have shown themselves which had been little, if at all, observed before in connection with Mangolds here. Last summer, besides the almost regular yearly attack of Leaf-blister Maggot, we had a bad infestation of the Black Aphis, the *Aphis rumicis*, commonly known as "Colliers" (and as a crop-pest chiefly infesting Bean-shoots), on Mangold-leafage near Llandudno, in North Wales; also the *Silpha opaca*, or Beet Carrion Beetle, a rare attack, but sometimes exceedingly destructive where it does occur; and the *Atomaria linearis*, called, from its minute size, the Pigmy Mangold Beetle (also rare, and also very destructive from the myriads in which it occasionally ravages at the young Mangolds), were again observed.

So far as I am aware, the above-mentioned kind of Black Aphis, the *A. rumicis* scientifically, although in the words of Mr. G. B. Buckton it is "almost omnivorous," has not been previously trustworthily identified as a Mangold infestation. In 1885, when Aphis-attack was one of the chief crop troubles of the year, there was uneasiness, both in England and Ireland, lest the quantity of Black Aphides on the Mangolds should prove to be the Colliers, the well-known pest to the tops of growing Beans. This, however (speaking, of course, only of the samples of attack sent to me for examination), I could quite certainly say they were not; but during the past summer I received a note of the appearance of this attack (that is, of Colliers) on Mangolds in one locality from Mr. Robert Newstead, Curator of the Grosvenor Museum, Chester.

On August 9th Mr. Newstead forwarded me specimens of Mangold-leaves infested by quantities of what proved on examination to be Colliers in different stages, with the following information:—"The leaves of Mangold I sent by this morning's post are infested with *A. rumicis*, Linn., and as I never heard of the species infesting Mangolds, I thought you would be interested to have specimens."

Mr. Newstead wrote me that the attack was a very bad one, and the locality of the outbreak was near Llandudno (in North Wales, at the mouth of the Conway), and further, that if I wanted more specimens he had "an enormous quantity of infested leaves." These, however, were quite unnecessary, for the quantity of Aphides forwarded appeared to me to leave little if any doubt of the attack being that of *A. rumicis*. The following description, chiefly taken from that of Mr. G. B. Buckton,* gives some of the chief characteristics by which this kind of Aphis may be distinguished from other black, or chiefly black kinds which are to be found on Mangolds or allied plants.

Aphis rumicis: Wingless viviparous female.—Head, thorax, and abdomen almost confluent. This massing together of the chief divisions of the body is well shown in figure 4, p. 51, of the wingless female, magnified. Eyes black; body wholly black; cornicles (honey-tubes) and tail black.

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* See 'British Aphides,' by G. B. Buckton, F.R.S. (Ray Society), vol. ii.

Winged viviparous female.—Wholly black customarily, but occasionally of a slightly rusty-brown, and when changing from the pupal state brown, with honey-tubes and horns green, soon, however, gradually changing in tint to shining black; wings short and coarse, with fore-edge and patch on it greenish, other veins brown.

Egg-producing female.—Very like the above-mentioned wingless form.

Male.—Black and winged.

Young.—Slaty-grey, afterwards with "a blackish velvet-like coat."

Pupa.—Head and fore body slaty-grey, with the wing-cases black. "Abdomen black, with four strongly-marked white downy spots ranged on each side, followed by a break near the insertion of the cornicles. Two small white patches occur on each side near the tail, and also an exterior row of dots on each lateral edge. These squarish markings give the insect a kind of chess-board or chequered appearance."—(G. B. B., *loc. cit.*)

The two other kinds, which so greatly resemble the above that they may very possibly be confused with it, are *A. papaveris*, Fab., and *A. atriplicis*, Linn. The first of these is known to frequent Mangolds; the second is to be found on *Orache* and other plants of the same order as that to which the Beet or Mangold belongs. Both these kinds are stated to have the *pupæ* (that is, the stage in which the insect, if winged when perfect, bears wing-cases) spotted with white. But in the "*papaveris*" the females are more of an olive-green tint; and the "abdomen of the winged viviparous female is olive-green, with three or more dark lateral spots on each side, and several obscure transverse bands." In the case of the "*atriplicis*," the winged viviparous female has the body of a dark olive, and the "abdomen very large, obscurely barred with black, sides spotted."

Where the insects in all their stages are submitted for examination, and are typical in their markings, they may be pretty surely identified, and in addition to the definite statement of Mr. Newstead (who is perfectly qualified to give a trustworthy identification) as to the infestation at Llandudno being of the *A. rumicis*, it appeared to me to be so; still, the differences between the three species above-named are so very much involved, that it is difficult to speak with quite absolute certainty.

Amongst the various observations of Mangold-attack sent me, none of the others appeared referable to presence of *A. rumicis*; but by favour of the Editor of the 'Agricultural Gazette' I received, on Aug. 9th, specimens of such an utterly overwhelming attack of mixed nature, including Aphis infestation as the chief part of it, that I give my description as printed in the 'Agricultural Gazette' of Aug. 12th, at p. 155:—

"Your correspondent's Mangold-leaves show a most seveve attack of Aphides, commonly known as 'Plant-lice.' I have seldom seen Mangold-leafage so coated with cast skins, dirt, and mould or fungus. But in the specimens sent me the insect attack, from its very intensity, appears to be killing itself out; there are myriads of cast skins, but I find very few live Aphides, and from the way in which the old skins are massed together with mould, the presence of oth r fungi, and the discoloured and sickly appearance of various of the live Aphides which are to be seen, I should hope that they were infected, and were being killed by the mould.

"But with regard to remedy, I do not see that any dressing can be applied to clear the leaves. Even in a bowl of water, and after soaking, it takes some rubbing with the finger and thumb to clean the leafage even moderately. On getting the dirt off, I find brown patches, which may have very likely been originally caused by the Mangold-leaf Maggot burrowing between the two sides of the leaf; but in the present condition the patches show only as destroyed portions."

The contributor of the specimens had mentioned that he had sown 1 cwt. of nitrate of soda per acre over them with no effect; and regarding this I suggested:—

"Probably nitrate of soda is the very best of all applications, for it will keep up the growth of the plants under attack if anything will; but I would suggest clearing away coated leaves, lest the fungus of other kinds besides the filmy growths (commonly known as mould) should spread to the sound leafage.

"Mangolds have such great power of 'recuperation,' so to say, struggling up to a good paying crop where even a small centre, *if* healthy, is left (after the cause of evil is removed), that I would certainly suggest to your correspondent that any application to drive on growth would be the best form of treatment; and of such applications, guano, soot, and also mineral superphosphate, have all been found to do good, especially the last-named. But nitrate of soda stands, so far as I know, quite at the head for efficiency."—(E. A. O.)

In these kinds of infestations there seem only three ways of dealing with the matter,—one that of killing the Aphides; but, though this can be managed by use of soft-soap mixtures, as in Hop-washing, or on Aphis-infested fruit-trees, it appears next to impossible to bring the plan to bear in the case of large-leaved field-crops like Mangolds or Turnips.

Another point which deserves very attentive consideration is checking increase of attack by destroying, as far as can safely be done, the infested leafage. Where the leaves, as in the attack mentioned above, have ceased to be useful, there is no reason against removing them, with a good hope that if the centre is still healthy the plant may be saved. The power of making a fresh start when growth is well pushed forward by stimulating manure is excellently shown by the following observation of successful treatment of badly attacked Mangolds at Rothamsted in 1890, which I was favoured with by Mr. J. J. Willis, by kind permission of Sir John Lawes.* In this instance the damage to the leafage was from Leaf Maggot, but the power of recovery of the plant would be the same whether outer leaves were destroyed by the Leaf Maggot within them, or Aphides sucking their juices, or Beet Carrion Beetle clearing off the leafage bodily down to the centre.

The Rothamsted observation was as follows:—"*Insect injury*, 1890.—A field of Yellow Globe Mangolds of fourteen acres on the farm of Sir J. B. Lawes, at Rothamsted, was badly attacked by the Mangold-leaf Maggot (*Anthomyia betæ*). The field was manured with twenty tons per acre of farmyard dung, applied just previous to sowing the seed. The injury commenced in July, and gradually got worse, until the leaves of the whole crop had the appearance of being scalded. They were of a brown colour, and greatly shrivelled up.

"In the first week of August an application of 2 cwt. of nitrate of soda per acre was sown broadcast over the whole field. The injured leaves soon died off, and the plants formed new growth. The crop was taken up towards the end of October, and gave an average produce of almost eighteen tons of roots to the acre."—(J. J. W.)

The above is a first-rate example of the well-known power of the Mangold to recover itself from effects of attack under favourable circumstances, and when the cause of evil has ceased of itself, or been removed. Also it shows the prudence of the rule laid down, not to be over-hasty to plough in a much damaged Mangold-crop.

But whilst we all know the importance of a proper amount of strong healthy leafage for formation of good roots, it is an open question whether we should not benefit very much in lessening insect infestations at a small quantity (if any) of loss to size of roots by removal of *superfluous* leaves. This is independent of cutting off leaves which are badly infested, which it is obvious is desirable when they are doing little excepting acting as a nursery for pests.

But if we look back to the early days of Mangold-growing in England,† when the gold medal of the Society of Arts, &c., was awarded to Leonard Phillips for his successful work in the introduction of this root, it will be found that very much more was then customary in the way of taking a portion of the leafage for fodder than is now done; and taking data at the two ends of special record, before the custom fell into disuse, we have roots raised in November, 1816, after six successive strippings of leaves, giving a weight of 20 lb. each and upwards; and in 1860, the special experiment at the Model Farm, Glasnevin, when of two lots of Mangolds grown precisely similarly in every respect, excepting removal of leafage, the plot from which 5 tons of leafage per acre had been stripped gave a return of 45 tons 1 cwt. per acre, whilst of those from which no leafage had been taken the return was 40 tons 8 cwt. 6 qrs. per acre.*

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* See my 'Report on Injurious Insects for 1890.'—Ed.

† See 'Farmers' Journal and Agricultural Advertiser' for April 8th, 1816, of which Journal (the precursor of our 'Bell's Weekly Messenger') a series was kindly placed in my hands for reference.

No doubt, to quote Prof. Wilson when writing on this point, *the practice is quite opposed to our knowledge of vegetable physiology*, but it is worth serious consideration that it was not until a few years after the custom of some amount of leaf being removed had fallen into disuse that trouble began about Mangold-leaf Maggot, this increasing until, about 1876, it appeared as a really severe attack, and now as a yearly trouble. Also, instead of Mangolds being now a crop remarkable for freedom from insect ravage, the list of its infestations would rank with those of almost any of our field-crops.

It would be unreasonable to advocate removal of healthy good leafage; but a middle course between stripping for fodder and letting the whole of the old outer leaves remain when they have got to the stage of often overshadowing each other, and their own serviceableness being lessened by age, injury of different kinds, and decay, appears worth consideration.

The third important point as a remedial agent is any application to push on good growth; and connected with this, as a preventive, the thorough cultivation beforehand, which will push on growth, and be returned well as to cost if no attack comes; and if it does, will give the crop a good chance of growing past it.

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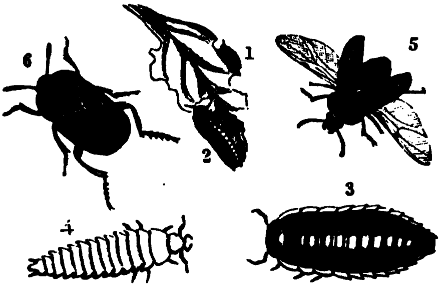
* For details, see quotations in Appendix to my 'Sixteenth Report on Injurious Insects.'

Beet Carrion Beetle. *Silpha opaca*, Linn.



SILPHA OPACA.—1-4, larvæ, nat. size and magnified; 5, 6, beetles, magnified, natural length about five lines.

Beet Carrion Beetle is an attack which is seldom noticed, but which is exceedingly destructive at times to young Mangolds; and in the past season I was favoured with the following note of its persistent recurrence for the past few years to a slight extent, and its very bad attack in the past season on ground at Batworthy, Chagford, near Newton Abbot, Devonshire, by Mr. F. N. Budd:—"You may remember that four years ago I reported to you an outbreak of the larvæ of the Carrion Beetle in my Mangold-crop at Batworthy, a small farm on Dartmoor, a few miles from Chagford. You gave an account of the occurrence in your Report for the year 1891, of which you kindly sent me a copy.

"My Mangolds have suffered slightly from the larvæ every year since, but this year the crop (luckily a small one) has been almost entirely destroyed by them. I am sorry that, not being in residence, I have been unable to make any careful observations; but a visit to Batworthy a few days ago showed me the crop nearly destroyed, and the larvæ present in great numbers."—(F. N. B.)

These larvæ, or grubs, are black (so that they are not always recognized as being really grubs); they grow to as much as five-eighths or nearly three-quarters of an inch in length, and much resemble in shape the creature known as a Wood-louse. There is, however, some variety both in shape and colour. Occasionally the grubs have a narrow tawny-coloured edge, and sometimes, as shown at figure 3, they have the exact Wood-louse-like shape; sometimes they are narrower, as shown at figure 4 (in outline), and it is this shape which I have most frequently received. The rounded edge of the three segments behind the head, and the sharp edges of the succeeding segments, giving a saw-like appearance to the sides of the grub, are characteristic.

The method of attack was found by Mr. D. Sym Scott, of Ballinacourte, Tipperary, Ireland, in his observations, sent me in 1888, to be feeding mostly during the evening and early morning when the leafage is moist, taking the young leaves first and eating them down to the soil. When these were finished, the maggots attacked the tender root, sometimes gnawing it off for about a quarter of an inch below the surface of the soil. The attack, judging by the various observations sent, lasts from early in June until towards the end of July. When full-fed, the grubs go down about three or four inches deep into the soil, and there change to chrysalids; and if undisturbed the new presence of beetles from these chrysalids may be expected about three weeks after the disappearance of the maggots.

The beetles average five lines in length, flattish, brown-black, and slightly downy, and have three raised lines along each wing-case (see figures 5, 6, p. 57), and are to be found during winter sheltering under clods or stones, or in moss or rotten wood, and, later on in the year, are to be found in dead animals. From this double nature of food they take their double name of Beet Carrion Beetles; and in grub-state, although I have never absolutely seen them feeding on putrid meat, specimens under observation to which I gave nothing but meat gradually becoming putrid for food, remained for so many days lively and hearty, that it was presumable they fed upon it.

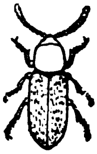
This attack does not seem to be increasing, for in 1888, the first year (so far as I am aware) of it being observed as a crop-pest in England, a few observations were sent of it doing mischief at localities widely apart, and of greater amount of its presence in Ireland. In 1891, the second year in which I had observations of it in England, it was only reported from one locality, namely, from Batworthy, in Devonshire (mentioned above), and now again in the past season the only reports sent of its reappearance are its bad attack at that locality; and also I have information from Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, of it being present there also.

No new information has been given as to methods of prevention; but where crops are destroyed so that the ground is cleared, it should be remembered that just then (for about three weeks after the disappearance of the maggots) they are going through their changes to the beetle-state only about three inches below the surface, and cultivation that will break open the soil just to the depth at which they are lying will in various ways much lessen their numbers, and especially if quick-lime, or a light dressing of gas-lime, is thrown. If circumstances allow of the land being left clear for a month, probably a dressing of two tons per acre, the amount considered quite safe under the above circumstances by the late Dr. Aug. Voelcker, would do a great deal towards clearing the infestation. Also with this attack, when it is a question of ploughing in the young Mangolds on account of severe injury *then going on*, it would be desirable to collect some of the grubs in order to ascertain whether they are nearly full-grown. If they are between half an inch and three-quarters in length the attack is almost certainly nearly over, and if there are still centres of leafage remaining to the roots, and conditions of ground and weather are favourable for growth, it may quite be hoped that the plant will recover. The grubs should be looked for at night, that is, as late in the evening, or early in the morning, as may be conveniently practicable, or, if this cannot be done, by searching in the ground round the attacked plants they would be almost certain to be found.

I am not aware of the effect of deterrent dressings having been tried, but it would be well worth while to see whether soot and lime, well mixed, and liberally scattered over the plants in the evening when the grubs are coming up to feed, would not have a good effect. The well-known mixture of quick-lime and gas-lime, about one bushel of each, and soot and sulphur in lesser quantities, all powdered up fine and mixed well together, and applied in the evening *when the dew is on*, could hardly fail to do good.

Early sowings have the best chance of escape because the plants have got to some degree in advance of growth before they have to bear the brunt of the attack, and all measures that give a hearty growth are of course important. But where this attack occurs, and the ground can be spared for a few weeks, it would appear that the best treatment of all would be to lightly stir the surface of the soil when the maggots are changing to chrysalids, and at the same time to give as strong a dose of fresh gas-lime as a dressing as may be judged safe, and thus it might be hoped stamp out the trouble.

Pigmy Mangold Beetle. *Atomaria linearis*, Stephens.



ATOMARIA LINEARIS (after Taschenberg).—Natural length one twenty-fourth of an inch.

The attack of the Pigmy Mangold Beetle is probably the cause of a great deal more mischief than is generally known. From its exceedingly small size—for it is only about half a line, that is, one twenty-fourth of an inch, in length—it escapes observation, unless noticeable from the enormous numbers in which, where there is serious attack, its presence occurs. But even then, as its attack is to a great extent below ground, this causes the myriads in which it appears to be sometimes confused with a visitation of Red Ants. The exceeding minuteness of this Pigmy Beetle makes it almost impossible to show even its length and breadth in a figure of natural size, and in farm-work it would be quite impossible to distinguish it accurately without the help of a strong hand-magnifier.

When so examined, it will be found to be of the shape figured (much magnified) at p. 59, that is, long and narrow; it is slightly flattened above, and downy, and in colour varying from rusty-red to brownish-black. The horns, or antennæ, are slender, terminated by a three-jointed club, and chestnut-coloured; feet also chestnut-coloured. Wings ample.

The mischief is done by the beetle first attacking the root (first of all the tap-root) of the young Beet or Mangold. This occurs early in the season. In 1892 the late Prof. Harker wrote to me, on the 27th of February, from the Royal Agricultural College, Cirencester:—"I think I mentioned to you that I found myriads of a small *Atomaria* at our Mangolds last spring, when we lost about half the crop." With this, Prof. Harker forwarded me various extracts on the subject of the attack of the *Atomaria linearis*, first observed in the year 1889 by Armand Bazin, of which he observed that they most accurately described the appearance of the attacked Mangolds, and that he "could have collected hundreds of *Atomarias* at each plant." Also Prof. Harker remarked that he had not thought previously that they were such severe pests.

From collating the accounts of various Continental writers, it appears that even by the middle of June the beetles may be found to have been seriously injurious to the coming crop by gnawing little holes in the germinating plants, so that they perish before appearing above ground; or, again, by so injuring the young plants that, where the leaves have appeared, they die off, and on examination the lower parts of the stalks are found to be eaten below ground-level. The root also is found to be gnawed in places, and these wounded parts to have turned black, and if the earth is carefully turned back, the little beetles will be found at work.

Later on, especially in bright warm sunny weather, the beetles may be found working at the leaves, and causing at times great damage; and on warm evenings the beetles come out of the ground, and, rising in the air, they pair; but where the eggs are laid, or the maggots feed, does not appear to have as yet been certainly observed. Presumably it is at the Beet- or Mangold-roots; but as the beetles themselves are only about as long as two-thirds of the height of the (o) in *this* word, it is matter of no small difficulty to be sure of securing their eggs or larvæ in the open field.

How far this infestation is a regular cause of mischief to young Mangold-plants we do not know. Enquiries are sent, and long have been, as to what may be amiss, but it was not until we had the careful observations of Prof. Harker, above alluded to, that we knew of the little beetle being a serious field pest at times in this country.

During the past season, the only certain report of Pigmy Mangold Beetle attack which has been sent me was from Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, who noted the presence of this unusual Mangold pest, as well as of the Beet Carrion Beetle. But if when the quite young plants are dying unaccountably the specimens for examination were carefully raised with the earth adhering to them, and forwarded, so secured that the beetles, if present, could not escape in transit, we might learn a great deal as to the cause of the dying off of germinating or young Mangolds.

Where attack has been present to an extent to make its recurrence likely, the chief measures recommended are bountiful manuring, so as to run on the crop, and also liberal seeding, so that if infestation comes there is a good chance of some of the germinating or young plants surviving, and thus giving a crop; or, if not, the superfluous quantity can be thinned out in good time.

Note.—MANGOLD-LEAF MAGGOT attack was present as usual last season, but as it occurs yearly, it is unnecessary to enter again upon the well-known applications which help to carry the plants over attack.

ORCHARD CATERPILLARS.

Winter Moth. *Cheimatobia brumata*, Linn.

Cheimatobia brumata.—Male moth; and female moths showing abortive wings.

The excessive cold of the early part of 1895 had certainly no effect in lessening infestation of the common orchard and fruit-tree caterpillars, as, for instance, the looper caterpillars of the Winter Moth, which did exceeding damage in various localities, not only to fruit-tree leafage, but also, and on a broad scale, to Oaks. Other kinds of caterpillars were more or less present; but the following notes are selected from the many observations sent me as bearing on some special points regarding the Winter Moths which it may be useful to draw attention to without repetition of what has been previously entered on.

Mr. Masters' prediction (sent on February 25th) of coming infestation shows the use of being alert in autumn whether moths are expected or not.

Mr. Goodwin's note gives definite observation of continuance of moth appearance from about the end of October up to the end of December. This is a very important point practically; and Mr. Goodwin's observation of finding Winter Moths out on the night of the 1st of March confirms previous observations of late appearance of this pest. All this joined to what we previously know of dates of appearances during the winter showing that though grease-banding at the time of the first great autumn outbreak is a most useful preventive, still that it is by no means to be wholly trusted to as an entire check to the ascent of the female Winter Moths without unreasonable amount of renewals in the later winter months.

The special kinds of trees selected for bad attack in various neighbourhoods, and amongst these the great outbreak of looper caterpillars on the Oaks of the Peckforton Hills in Cheshire, are also worth notice; but during the season of infestation, short observations of the unusual amount of mischief going forward were so frequently added to report letters regarding other insects, that more than just the chief points mentioned would be undesirable.

The following useful note, the first of the season's observations on Winter Moth, was sent me on February 25th from Evesham by the courteous and friendly contributor whom now I greatly regret to name as the *late* Mr. J. Masters:—"I am very much afraid we shall have a severe visitation of the caterpillar pest this season. Last year the caterpillars were not numerous, and many growers presuming on this would not take the usual autumn precautions. I caught more moths on the grease-bands last autumn than I have done for some years past. The severe winter has also been very destructive to small birds, so that we shall not have their help to any extent in lessening the brood of caterpillars this spring."—(J. M.)

Mr. Goodwin wrote from Canon Court, Wateringbury, near Maidstone, on the 25th of February, as follows:—"Since I last wrote to you, I have carefully studied the habits, &c., of *brumata.* I had a very good opportunity, as an orchard close to the house was severely attacked last year by the larvæ of *brumata.* Round these I had the usual sticky bands put, and took great care that the composition was not allowed to get dry. Every evening I went out to see what was happening. They commenced to emerge about the end of October, and continued to appear up to the end of December.

"The number of males and females caught on some of the trees was extraordinary. I could not count them, but there were several hundreds on one tree, and it might have run to four figures. At least ninety-nine per cent. were *brumata,* the rest being *defoliaria* and *dilutata.**

"I also found that a considerable number of eggs are deposited on that part of the tree between the earth and the band. From close observation I could see that the females object to walking on to the sticky composition, and will delay doing so for some time, during which they deposit eggs in the crevices of the bark. I have no doubt that the larvæ from these eggs (unless they are destroyed by some means) would succeed in reaching the foliage. My grease-bands were not put very high up—only about three or four feet from the ground; but of course where stock is turned out, the bands must be put proportionately high, and the risk of having a large number of eggs below the band becomes greater.

"One thing I noticed was the comparative rareness of *defoliaria.* In the spring five or ten per cent. of the larvæ were of this insect, but certainly not more than one per cent. of the moths were *defoliaria.* This was equally noticeable in my breeding-cages. Roughly speaking, about fifty per cent. of the *brumata* emerged, but only about five per cent. of the *defoliaria*."—(E. G.)

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* *Cheimatobia brumata,* the Winter Moth; *Hybernia defoliaria,* the Mottled Umber Moth; and *Oporabia dilutata,* the November Moth: all three species resembling each other in the moths appearing in autumn, or early winter, and their caterpillars infesting leafage in spring.—ED.

About a week later (namely, on the 4th of March) Mr. Goodwin wrote me that whilst searching for insects on the night of the 1st, he had found several "pairs" of *C. brumata*. It is impossible to say with certainty when these had emerged from the chrysalis state; but the circumstance of their being pairing points to their very recent development. Although the chief appearance of the Winter Moths is from the middle of October some way into November, we have record of their appearance as late as the end of January, and the possibility of a late development in March is one of the difficulties of fruit-growers.

In the instance observed by Mr. Goodwin, it would appear very likely that the long frost-bound state of the ground had prevented an earlier appearance of the late winter brood; but in any case the observation is of serviceable interest as showing the moths present and in natural condition immediately on the breaking up of the long cold.

Amongst widespread mischief done by the looper caterpillars in the past season, one very notable attack was that to the trees on the Peckforton Hills in Cheshire. On the 31st of May, Mr. W. Bailey, writing to me from the Aldersey Grammar School, Bunbury, Tarporley, Cheshire, on this subject, mentioned:—"The foliage on the Peckforton Hills is this year again being destroyed by caterpillars; . . . the *Oaks* are especially suffering." With his letter Mr. Bailey forwarded me a box of caterpillars collected from the Oak-trees, all of which proved to be "loopers," and almost all were caterpillars of the Winter Moth.

The above attack appeared as a devastation to *Oak-leafage;* the following report, sent me by Messrs. German & Son, from Ashby de la Zouch, on May 29th, shows extremely bad attack to *Lime-trees.*

This attack, it will be seen from the following communication, was a recurrence of infestation of the previous year, and the locality Drakelow Park, near Burton-on-Trent. Messrs. German mentioned that on June 27th, 1894, I had replied to a letter from them regarding a caterpillar attack upon Lime-trees in Drakelow Park (near Burton-on-Trent), but it was then too late in the season to send specimens. Unfortunately, however, the attack had then recurred, and specimens were forwarded. These proved to be Winter Moth caterpillars of various shades of colour, some with green ground-colour, some much browner, and some of them were full, or nearly full-grown.

The bundle of leaves sent accompanying showed great ravage. Of the seventeen or more leaves sent (for the most part averaging about three inches in length), few, if any, had less than a third eaten away, some much more, and some were reduced to merely a few ragged remains.

The above observation of severity of attack of the caterpillars was, it will be seen, on May 29th, and it is worth notice that in about a fortnight from that date the caterpillars were entirely gone from the trees. On the 12th of June Messrs. German wrote me that "on examining the trees on Monday last" [June 10th, Ed.] "we could not find a single caterpillar. We suppose therefore that they had fallen to the ground, where they will exist in the chrysalis state until they become moths, about the beginning of October."

This matter of disappearance of great infestations of caterpillars, whether of Winter Moths or of other kinds, deserves much more attention than is usually paid to it. Messrs. German, as above noted, quite understood what it meant, namely, that the larvæ were only gone down into the ground to lay the foundation of new mischief. But too often the disappearance of the great body of caterpillars is considered to mean that this is an end of the whole affair. Consequently no measures are taken, and the next attack (which in field cultivation might sometimes have been quite prevented, and with Winter Moth might have been prepared for) takes place in natural course.

The following note, sent me on May 25th, with specimens accompanying, by Mr. H. Fawke, from Green Hill Farm, near Kidderminster, shows recurrence of attack of the Winter Moth caterpillars to Plum and Gooseberry for several years :—"I have sent you a sample of the pest that we have been troubled with for the last two or three years; they devour both Gooseberries and Plum alike."—(H. F.)

On the 14th, and again on the 17th of June, Mr. G. F. S. Warne, writing from Frolbury, near Dorking, reported a plague of caterpillars, "which this year is worse than ever," which had infested trees in that part of the country, and done great damage to the Oaks, which had especially been attacked, and also to fruit-trees, &c.

In regard to methods of prevention and remedy, the two great points to be considered are, the measures which will keep the abortive-winged moths from ascending the trunks of the trees, and also the applications, such as washes, syringings, &c., which will be serviceable when, either in natural course of things, or from the stems of the trees not having been sufficiently guarded, the caterpillars are found to have established themselves, and to be devastating the leafage. The following is a short account of how we stand regarding knowledge of these methods of treatment at present.

In 1889, consequently on the constantly increasing and serious amount of loss caused by "looper" caterpillars, for which there was no regularly proved reliable remedy, the subject was gone into with great care by fruit-growers on a large scale, and others personally interested in the matter. Grease-banding, though a great preventive, was found to be by no means wholly successful, and on application being made to Mr. J. Fletcher, Entomologist to the Dominion Experimental Farms of the Department of Agriculture of Canada, he suggested the use of spraying with Paris-green, as being decidedly the most successful treatment known for stopping ravages of the caterpillars of the Winter Moth.

Consequently on this, a Committee of Experiment was formed early in the following year at Evesham, composed of leading men,—fruit-growers, landowners, and others of that great fruit-growing district,—in order by trials, joint examination of results at the meetings of the Committee on the fruit-grounds of the members, and publication of results (successful or otherwise), with causes duly noted, that we might have well-proved information as to trustworthy treatment.*

Taking first the subject of banding. We found that tar (an old standing method of prevention) was wholly objectionable by reason of it soaking into the bark of any of the trees not old enough for the bark to be a mere rugged dead mass externally, and thus doing serious or fatal damage.

In regard to grease or sticky banding, we found that, though not so dangerous as tar, if spread on the bark without care as to amount, composition, and also the age of the bark, it was liable to do harm, varying in amount up to killing the trees. Therefore the plan of protecting the part over which the grease was to be applied by a band of grease-proof paper was arranged, this band of paper being tied round with a string at the upper and lower edges, and the grease smeared on to it.

Enquiries are frequently sent me as to what kind of cart-grease should be used; but from the vast number of kinds of cart-grease or axle-grease it is almost impossible to single out any one kind for special use. So far as any regular formula can be given for common cart-grease, it appears to be usually made of tallow, palm-oil, and soft-soap; another kind is mainly of rosin-oil, with apparently a little rosin, and also a little carbonate of lime; yet another useful kind, known as Frazer's axle-grease, is of rosin-oil saponified with a solution of Sal-soda in water and softened lime. These may be taken as types of "grease" which, *beyond the action of the grease itself*, will not do harm, even if smeared on the bark.

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* Details will be found in my Thirteenth, Fourteenth, and Fifteenth Annual Reports. In the first-named, besides other information, under the head of "Orchard Insects," will be found some special observations on sticky banding. The second-named (that for 1890, in which the Experimental Committee of Fruit-growers was formed) enters more particularly on details of our work in regard to introduction of use of Paris-green; and in the Report for 1891 are further notes, and directions for the use of Paris-green; and also some observations on mixture of soap and Paris-green, with which I was favoured, at my request, by Dr. J. Aug. Voelcker, Consulting Chemist of the Royal Agricultural Society of England; and notes of experiment by Mr. Frank T. Shutt, Chemist to the Experimental Farms of the Department of Agriculture of Canada.

Others, however, will do great harm to bark: of these, such a composition as "Pitt's axle-grease" would probably do immense mischief if used as a smear to be laid on the bark itself. This mixture is stated to be composed of black-oil or petroleum residue, animal grease, rosin (powdered), soda-lye, and salt dissolved in a little water. Where, however, "grease-proof" paper is *really impervious* to greasy or injurious external applications, of course almost any sticky insect deterrent may be smeared on it; where the paper is *pervious* (as may very likely be the case) damage occurs just in proportion to its inefficiency. The practical difficulties connected with "greasing" or "sticky-banding" are,—the material drying so quickly that it ceases to be sticky; or, again, where great numbers of moths are stuck fast, the bodies of these make a coating outside the sticky material over which the ascending moths may creep in safety. This is a difficulty which may very soon occur, as the male moths, being attracted to the bands by the females, a coating or sprinkling of both winged and wingless moths is soon formed.

Yet another point to be considered is deposit of eggs. Numbers of these are laid on the bands by the "stuck fast" female moths, and of these it just depends on various circumstances whether many or few will hatch out their caterpillars in due course to ascend the tree in spring. Also there is an almost certainty of an egg deposit *under the lower edge* of the sticky band, beneath the part where it is tied to the tree.

All the above matters need looking to if "sticky banding" is to be successful, and for most of them another application of the smear is enough; but the really great difficulty in the matter lies in the successive or long-continued appearances of the moths. These may go on, as noted by Mr. Goodwin at p. 68 (to take one of the observations of the past season), for a couple of months, or they may recur at intervals during the winter from the middle of October to the beginning of March, and it appears to me totally impossible to guard against this at a paying rate in great orchards where trees are grown by thousands. The greatest number of moths, the great force of the attack, however, appears to be that which comes the first, the great infestation of the latter part of October and earlier part of November; and to check this in its ascent makes an enormous difference in amount of coming evil. And here we pass to the *remedial* measures, which the imperfectness of preventive measures makes imperative only too often in the following spring.

When the caterpillars are found to be at work on the leafage, the only treatment which appears to be of really trustworthy service is washing or spraying with applications that make their food poisonous to them, or so obnoxious to them that they will not feed on it.

For this purpose spraying with Paris-green holds the first place as an application of *certain benefit*, if applied according to the methods which have been carefully worked out as to strength, &c. London-purple, which is also an arsenical preparation, is also (in proportions fixed) very serviceable. For those who object to such amount of risk as may arise from careless application of poisonous mixture, the use of "Kerosene Emulsion" is thoroughly to be recommended; or for those who have not the knack (or do not desire the trouble) of mixing the soap and kerosene of the emulsion so that they are permanently blended, the composition sold under the trade-name of "Anti-pest" by Messrs. Morris, Little & Son, Doncaster, will probably do all that is required. This composition is very similar in the nature of its ingredients to the "Kerosene Emulsion," but being ready mixed, and only needing diluting, it saves trouble, and is much safer for the leafage than imperfectly blended emulsion, in which the separated mineral oil may do a great deal of damage.

There are other mixtures sold more or less serviceable, of which those I know best are the compounds prepared by Messrs. Stott, one of which, sold under the trade-name of "Kill'mright," I have had well reported of. This, I believe (but am not certain), has Paris-green added to a basis of soft-soap, and therefore it would be likely to be serviceable, both by poisoning the food, as in the case of caterpillars, or by choking up the breathing-pores, as with Aphides and other insects which it is not easy to poison by dressing their food, as they pierce through the outer surface to get it from beneath with their suckers. The serviceableness of soft-soap in this class of attacks has long been shown by the use of soft-soap washes for Hop Aphis.

In regard to recipes.—One for use of London-purple will be found at p. 48; the proportions and method of application of Paris-green will be found in my own short pamphlet on its use, which I am permitted to say met the approval of the late Prof. C. V. Riley, Entomologist of the Department of Agriculture of the United States, as containing a plain and correct statement of all the points necessary to be known for orchard service. This I have copies of still, and shall be happy to send to any applicant. For the kerosene and soap emulsion there are various recipes; probably the following—which I copy from a useful little pamphlet on insecticides, sprayers, &c., published by the Deming Co., Salem, U.S.A.—will be found very serviceable, as it appends special details regarding use of different kinds of soap, and advice as to management of different kinds of water:—

"The Kerosene and Soap Emulsion.—This is made after the following formula: kerosene two gallons, soap half-a-pound, water one gallon, "The soap, first finely divided, is dissolved in the water by boiling, and then added boiling hot, away from the fire, to the kerosene. The whole mixture is then agitated violently, by being pumped back upon itself with a force pump and direct-discharge nozzle, throwing a strong stream, preferably one-eighth inch in diameter. After about five minutes' pumping, the emulsion should be perfect, and the mixture will have increased from one-third to one-half in bulk, and assumed the consistency of cream. It should adhere to glass without oiliness. Well made, the emulsion will keep indefinitely, or may be diluted for immediate application.

"The use of whale-oil soap, especially if the emulsion is to be kept for any length of time, is strongly recommended, not only because the soap possesses considerable insecticide value itself, but because the emulsion made with it is more permanent, and does not lose its creamy consistency, and is always easily diluted, whereas with most of the other common soaps the mixture becomes cheesy after a few days, and needs reheating to mix with water. Soft-soap answers very well, and one quart of it may be taken in lieu of the hard soaps.

"In limestone regions, or where the water is very hard, some of the soap will combine with the lime or magnesia in the water, and more or less of the oil will be freed, especially when the emulsion is diluted. Before using, such water should be broken with lye, or rain-water used; but better than either, use the milk emulsion, with which the character of the water, whether hard or soft, does not affect the result." *

In some cases where there is difficulty as to application of regular arsenical or other sprayings, fairly drenching (thoroughly washing down) the infested trees with water alone will do good. When attack is passing away it does much good, for it cleans off quantities of dirt and rubbish, and the copious watering of the ground in dry weather helps much towards giving the leafage a new start. Where there was plentiful supply of water at hand, and the use of a house fire-engine was procurable, I have known this answer well; only in such violent application the water should be sent rather at the trunk and main boughs, and allowed to rebound at the leafage rather than be sent directly at it, which might complete the destruction of the remains which had escaped the caterpillars.

Where there is some tree which for special reasons—legal, picturesque, or otherwise—it is important to save from ravage, and which is of too great a height to be cleared by ordinary spraying-engines, the above method will probably be found serviceable. If it should be found that the fallen caterpillars show signs of being able to crawl

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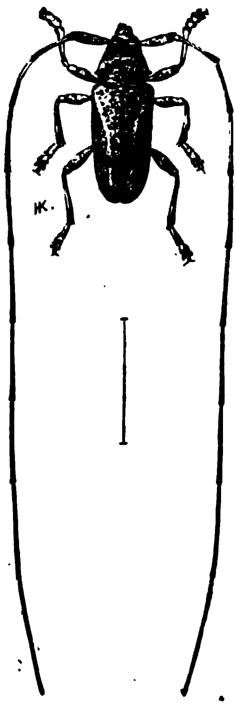
* 'Catalogue and Price List of Spraying-pumps, &c., with Recipes for Insecticides and Fungicides,' pp. 16, 17. Deming Company, Salem, Ohio, U.S.A.

back to the tree, they should, if possible, be all destroyed, or a sticky band put round the trunk at once.

Many minor methods of treatment have been found of service, as jarring the boughs to make the caterpillars fall, also fumigating, and numbers of other measures have been brought forward on variously trustworthy authority for a length of years; but looking at the records of known horticulturists in Canada and the United States, joined to those of our own country, it appears to me that, for real broadscale work, sticky banding in late autumn and early winter, and spraying in the spring when the caterpillars appear, are what we have got to trust to.

PINE.

Timberman Beetle. *Astynomus ædilis*, L.; *Acanthocinus ædilis*, S.



ASTYNOMUS ÆDILIS, slightly larger than life; line showing natural length.

The Timberman can perhaps hardly be classed amongst insects which are really injurious to Pine-timber in this country; but as it is rarely met with here, a note of its capture is worth record; and also the species is of interest from the males possessing the longest horns, or antennæ, of any of the known European beetles.

On the 12th of August the very beautiful specimen, from which the accompanying figure (a little larger than life) was sketched, was sent me by Mr. William Ross, from Kinnaird, Strathpeffer, Ross-shire, N.B., with the observation that it had been found on the farm on that day, and that neither the sender, nor any person to whom he had showed it, had ever seen one like it.

Short notes of the habits of the beetle will be found given by various German writers; but the best account I have at hand is given by the late E. C. Rye,* as follows:—"The *A. ædilis* is conspicuous for the enormous length of its antennæ, especially in the male. This . . . occurs at Rannoch" [in Perthshire, ED.], "where it may be not uncommonly seen flying across the glades of the Black Forest, with its long appendages streaming behind. It loves to settle on felled Pine-logs, with its antennæ spread out like compasses; from which habit it is termed by the Highlanders 'Timberman,' a name curiously enough also applied to it in Lapland and Sweden, where it is common. If two males come within range they inevitably fight, for which reason, and also on account of their delicate structure, it is difficult to obtain quite perfect specimens.

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* See 'British Beetles,' pp. 207, 208, by E. C. Rye.

"The larva makes wide galleries and perforations in Pine-stumps, forming a nidus, with coarse gnawed fragments near the surface, in which it changes to pupa. In this state the antennæ are turned downwards, and recurved towards the middle of the head. The larva appears to be full-fed at the beginning of the summer, and, after remaining two or three weeks in the pupa-state, changes to the perfect state; staying as such in its nest until the following summer."—(E. C. R.)

Excepting at the locality where the "Timberman" is mentioned by Mr. Rye as "not uncommonly" seen, it appears to be rarely met with in this country; but on the Continent it is to be found in great numbers.

Dr. Altum observes "that after hybernation it swarms on warm days in the early spring in forest clearings, where it flies about the stack-wood and stems. Sometimes it also winters in pupal state."

Kaltenbach states that according to various observers this beetle is common in Pine- and Fir-wood, and that he had himself taken thirty in one morning in a wood-yard about Pine-wood.

Dr. E. L. Taschenberg observes that the *Astynomus ædilis*, L., has in the case of the male the longest antennæ which are known to occur in any European kind. He also notes that it lives in larval state under Pine- and Fir-bark, often perforating the wood of the fallen stems.*

From the habit of the grubs of this beetle of feeding in the wood, as well as under the bark of felled Pine-timber, it cannot be looked on as a wholly harmless infestation, and if it should be found to occur in any observable numbers at any locality, it would be well to guard against its increase; just as with the *Sirex*, the Great "Wood Wasp," which not very many years ago was looked on as only a rare insect and not worth attending to, because it might be supposed only to damage sickly or felled timber, and now it has become a regular Pine pest in various places here, and its presence has spread onwards injuriously into Ireland.

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* The above references are taken from: 'Forst-Zoologie,' von Dr. Bernard Altum, vol. iii., "Insecten," p. 306; 'Die Pflanzenfeinde,' von J. H. Kaltenbach, p. 690; and 'Praktische Insekten-Kunde,' von Dr. E. L. Taschenberg, pt. ii., p. 256.

The "Timberman" Beetle is of the shape figured magnified, with natural length given by the line accompanying, at p. 70. The length varies from about half to three-quarters of an inch; the shape is depressed above, clothed with a greyish pubescence. The general colour above is of a brownish ash, or, as well described by Dr. Altum, of a smutty violet-grey, like Pine-bark. The fore body has one blunt tooth on each side, with four much smaller ones above placed transversely in front. The wing-cases have numerous minute black spots arranged to some degree in rows, and are marked across by two somewhat oblique brownish bands; the front one, in the specimen before me, only extending a little way from the outer edge. Legs chiefly grey or brownish, with grey down. The ovipositor is exserted in the female.

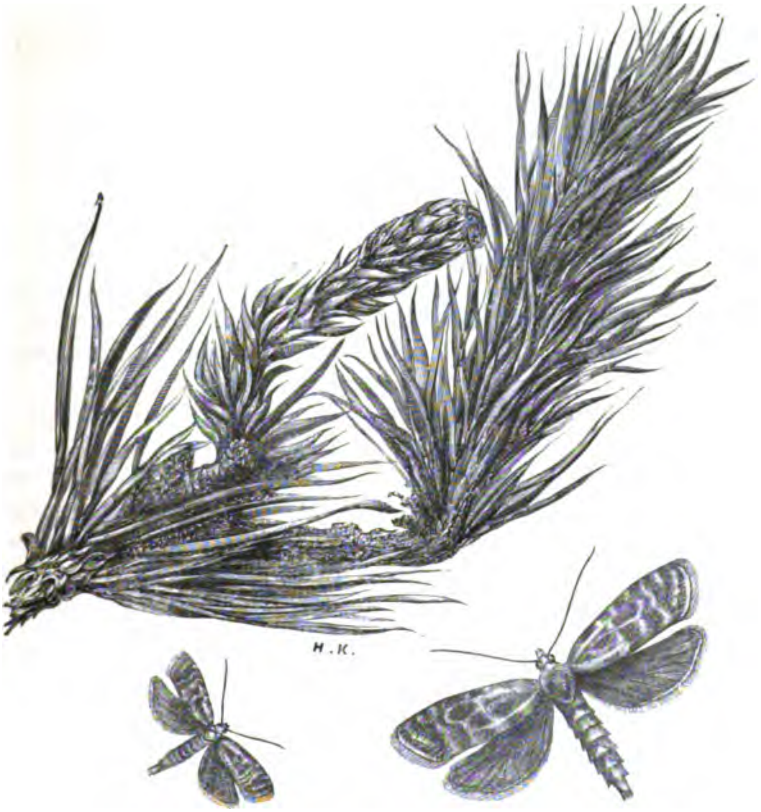
The distinguishing point, however, is the enormous length of the horns of the male beetle; these are from three or four times to as much as five times the length of the body, or, by measure, three and a half inches; the general colour grey, with a black line outside the lowest joint, and the others, excepting the terminal one, black at the apex; this joint is longer than the others, and very slender. The antennæ of the female are much shorter, only about twice the length of the body of the beetle. My own specimen was three-quarters of an inch in length; the expanse of its antennæ as it walked, bearing them at right angles to its body, was as near as may be half a foot; and as it moved gently along, with its delicate horns lightly arched from their strong enlarged lowest joint to their fine slender extremity, it formed a singularly graceful object.

Pine-shoot Tortrix Moth ("Post-horn" attack, German). *Retinia buoliana*, W. V.

On the 7th of June I received, by favour of Mr. R. Gough, Forester to the Duke of Bedford, from the Woods Department, Park Farm Office, Woburn, Bedfordshire, a parcel of specimens of injured Scotch Fir-shoots, with some insects accompanying, and a request for information as to the nature of the attack.

This proved, on examination, to be of the Pine-shoot Tortrix Moth, the *Retinia buoliana*. Just a few caterpillars were still unchanged to the chrysalis state, and with these, and the chrysalids, the moths, which after a time developed plentifully, and the characteristic distortion of the shoots from the larval injury which had taken place within, the attack was very well represented. The moths are said by Taschenberg to be found at the end of June, and in July from England to Russia and from Sweden to the South of Europe wherever the Firs which they infest are to be found; yet, curiously enough, although I have seen bad attack myself, no report has ever before been sent me of it as seriously injurious.

The history of the attack, condensed from the accounts of various observers, is as follows. The moths appear at the end of June, but chiefly in July, on young wood, and are mostly to be found on trees of ten to fourteen years old. Here they are little observable as they rest in the day amongst the needle-like leafage, but in the dusk of the evening they swarm about the tops of the trees; and here pairing takes place. The fertilized females lay their eggs singly between the buds at the end of the shoot, and from the gnawings of the caterpillars which presently hatch from these eggs during the later part of the summer, a flow of rosin results, which to some degree coats over the injured bud. Here the caterpillars hybernate, and with the growth of the spring shoots their presence becomes more noticeable. Then they often attack the neighbouring shoots, or one side of them, more



RETINIA BUOLIANA.—Moth, nat. size and magnified; injured shoot.

especially under the shelter of the resinous exudation and their spun web.

The result of the infestation is sometimes the growth of a number of small more or less deformed shoots taking the place of what should have been the leader, either to the young tree, or the affected bough, and thus giving a "besom-like" bunch of shoots round the destroyed terminal bud. Or very frequently the injured shoots assume a distinctly elbowed growth, as shown in my figure at p. 73, drawn from specimens sent me by Mr. R. Gough. The shoot may very possibly not be killed, and will in course of growth turn up again and resume the right direction; but a bent angle at the side that does not grow will have been established, and will cause a crooked stem.

Some of the shoots from Woburn showed the elbowed growth characteristic of this attack very plainly. The shoots of which the growth had been checked elbowed sharply to one side, and then, after a somewhat horizontal growth, or slightly downward inclination for an inch or two, turned up again, and continued an upright but diseased growth; the shoot thus having formed two elbows.

In some instances the whole part above the infestation was so checked in development as merely to be covered with brown or pale completely stunted leaves, or scales representing them, *i. e.*, buds containing the leaves which had not freed themselves from their sheaths, and lay imbricated to the amount of about one hundred on about two inches length of shoot; and in some the leaves, in their unnaturally close development, were produced up to about a third of their natural length.

Some of the chrysalids were, on June 17th, lying in the dead parts of the destroyed shoot, or in the chamber of web and exudation outside it.*

These I found to be extremely lively when laid in the hand. The colour was of a yellowish-brown, darker towards the thorax; and the head, and part covering the wings, dark. The abdominal segments lighter below, and at the base of seven of them up to the caudal segment a very narrow band on the upper part and sides of either very minute prickles, or minute prickle-like tubercles. These tubercles, or prickles, formed a line across the segment about a quarter of its width

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* Scarcely any of the caterpillars remained unchanged; the two or three which were visible were of the yellowish tint they assume before maturity. When young they are of a darkish brown; when full-grown they are about an inch long, with small shining black head; the next segment black or blackish-brown above, with some very fine white lines; and the tail also blackish. They are to be found, according to Taschenberg, from September until May of the following year between the buds of the Fir, and later on in the young shoots; and they turn to chrysalids at the spot where they ceased to feed.

from the hinder edge; and dividing the remaining portion of the segment across into about two equal parts was a raised line, formed on most of the segments of minute tubercles. These were very small, and my observation was taken with a two-inch focus hand-magnifier; but perhaps may be worth noting in addition to Taschenberg's observation of the half-ring of prickles pointing backwards at the tail.

The chrysalis state lasts for four weeks. On examining my specimens on the 19th of July, I found some of the moths had developed, and were dead, and so much rubbed that they were hardly recognizable. A good succession, however, afterwards emerged, agreeing well with the descriptions of the *Retinia buoliana*, W. V., especially that given by Taschenberg.*

The fore wings are of various tints of yellow or rich red, marked (as figured) with lines, stripes, and spots of beautifully shining silvery markings; the hinder wings are well described as "blackish-grey, with yellowish reflections, and the fringes mostly yellowish-grey."

The only other note which I have received regarding this infestation is from Mr. E. A. Atmore, F.E.S., King's Lynn, Norfolk, who, in reply to some remarks of my own regarding the above attack, mentioned: "The larva of the little moth *Retinia buoliana* caused considerable injury to the Scotch Firs here by rendering the shoots sterile. One of these grubs feeding in a shoot will quite ruin it!" To this Mr. Atmore added:—"*R. pinivorana*, *R. pinicolana*, and *R. turionana*, also cause some little injury here to the same trees (Scotch Fir), for their larvæ feed similarly to those of the *R. buoliana;* but none of these species are plentiful enough here to cause much injury. . . . *R. buoliana* is not particular as to which shoot, or bud of a cluster of buds, the egg is laid in; but *R. turionana* is just the reverse; it always, or nearly always, selects the central bud, or shoot, and causes much more resinous exudation than *buoliana*."—(E. A. A.)

The insect mainly chooses Scotch Fir, or Black Austrian Pine, for its attacks, but does not appear wholly to confine itself to them. In the very useful volume entitled 'Forest Protection,' by Prof. W. R. Fisher,† it is mentioned that the insect exclusively attacks young growth, and prefers weakly six- to twelve-year-old plants on poor soil, and in sunny situations. Methods of preventive treatment there given are:—

"Careful planting and rearing of plantations of vigorous Pines without undue crowding.

"The shoots which are attacked may be broken off and burned.

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* See 'Praktische Insekten-Kunde,' part iii., p. 200.

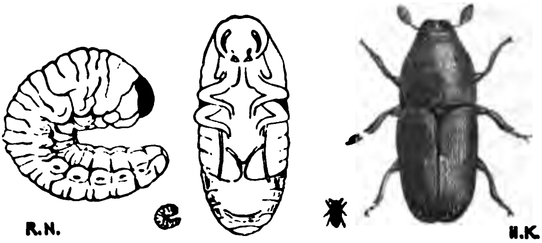
† 'Forest Protection,' by Prof. W. R. Fisher, B.A., Assistant Professor of Forestry, Royal Indian Engineering College, Cooper's Hill (being vol. iv. of Dr. Schlich's 'Manual of Forestry'). Bradbury, Agnew & Co., Bouverie Street, London. 1895.

"Removal of all misshapen stems at the first thinning, till which time they are spared to cover the ground."

Looking at the habit of the moths of flying round the tops of the infested trees in the dusk, and also that these trees are often still in reach of treatment by means of syringing, or by washes thrown from garden-engines, it would appear well worth trying whether the application of some of the various well-known kinds of soft-soap wash might not be very deterrent to egg-laying. The application of tobacco-liquor failed on trial; but the adhesive slight coating which would be given to the buds by the soft-soap mixture would especially lodge between them, and thus protect the exact locality which the Tortrix Moth selects for egg-laying. For a purpose like this the Eclair Knapsack Sprayer, sold by Messrs. Chas. Clark & Co., Windsor Chambers, Great St. Helen's, London, E.C., would be excellently adapted, as it could be carried on the shoulders of the bearer amongst the young trees, where there would be no room for the passage of a wheeled machine.

PLUM.

Wrinkled Fruit-tree Beetle. *Scolytus rugulosus*, Ratzeburg; *S. hæmorrhous*, Schmidt.



Scolytus rugulosus.—Beetle, larva, and pupa; all greatly magnified. The two latter from drawings by Mr. R. Newstead.

The above-named beetle much resembles the well-known Elm-bark Beetle, *Scolytus destructor*, Oliv., in its method of doing harm by working in grub state within the inner part of the bark and outer part of the wood, but is distinguishable (for one thing) by being a good deal smaller; the Elm-bark Beetle being from one and a half to as much as three lines in length, and the "Fruit-tree" *Scolytus* (to borrow one of its German names) only from three-quarters of a line or less to a line and a quarter long.

It is of the shape figured at p. 76, magnified, and shining, but (on account of its wrinkled surface) not so much so as the rather larger kind, the *Scolytus pruni*. The fore body is "extremely closely covered with deep oblong punctures, confluent into wrinkles in front and at sides." The wing-cases with punctures on the interstices as large and deep as those in the striæ. The tips of the wing-cases, the horns, and the legs are reddish-brown.

This kind is found on the Continent between, and feeding in, the bark and sap-wood of various trees, especially of Apple, Plum, and Cherry; but in this country it is not, so far as I am aware, recorded as more than "rather common," and until I was favoured in the past season with very good specimens of small boughs of Plum exceedingly injured by its presence, I was not aware of it being a decided orchard pest here.

On the 7th of June Mr. Robert Newstead, F.E.S., Curator of the Grosvenor Museum, Chester, wrote to inform me that he was sending me some pieces of Plum-branches infested with *Scolytus rugulosus*, of which he observed:—"By carefully removing the bark you will find the insect in all stages, *e.g.*, larva, pupa, and imago. The branches are from Plum-trees in my father's garden at *Ince, Cheshire*, where the attack has proved most destructive, as also at other gardens in the same village. I have also received it from Shropshire, where it had been equally destructive. I have now had the species under investigation for nearly two years."

Mr. Newstead mentioned that he had some notes of the life-history of the beetle, which he purposed shortly to publish; and he also kindly lent me his own drawing from life of the maggot and pupa much magnified, which, with his permission, I have had copied, and insert at p. 76.

The life-history, taken from various writers, is that the little beetles appear in May or April, and begin to bore into the bark; and the females tunnel their galleries in or between the inner bark and sap-wood. Here they lay their white eggs singly side by side along the "mother-gallery," and from these eggs the grubs hatch after a few days, and feed on the inner bark by preference, but otherwise in the sap-wood. The maggot-tunnels necessarily all start off, as with so very many of the bark-beetles, at right angles from the mother-gallery, by the sides of which the eggs were laid; and when full-fed, if there is still a good thickness of bark over them, they turn to chrysalids at the ends of their tunnels; otherwise, if the bark is too thin a protection from their having eaten it away, or from other causes, they pierce a little way down into the solid wood.

This was very observable in the small branches sent me. At first, from the short tunnel down into the wood being stopped at the outside with the powder (frass), the results of the feeding of the grub, the perforation was very likely not noticeable; but later on, when the beetles had developed and emerged, the minute shot-like holes into the wood were as observable as those through the bark, and were sprinkled in such numbers over the surface of the samples of Plum-branches sent me, that I counted sixty perforations at least in a space of one inch in width by two in length, the short tunnel varying in depth from about the sixteenth to over the eighth of an inch, and often entering the wood in a slightly slanting direction.

According to Dr. Taschenberg, the development of the beetles from the first laid eggs is completed by the end of June. This agrees with the state of the specimens sent me by Mr. Newstead. Of these he mentioned, on the 18th of June, that (so far) he had only been able to obtain three larvæ and one pupa. This certainly must have been referable to the grubs having left their tunnels and gone down into the wood, for on June 21st I found the beetles had been developing numerously. The dust which had dropped from their workings induced me to make a careful examination as to what had been going on, and at first only a few of the beetles were noticeable in the box; but on moving the pieces of infested branches, I found numbers of them were present, running about fast and actively.

In the case of Canon Schmidberger's observations, the larvæ continued feeding until late in the autumn, the beetles from these coming out in the next year; and it does not seem absolutely certain whether there are customarily two broods in the year. Where the beetles, however, come out in June, it is entirely presumable that it is the grubs from the eggs of these that furnish the beetles which come out in the following spring, and start attack as mentioned above.

The Plum-branches sent me (which were destroyed by the severity of the attack) were from a small size up to as much as four and a half and five and a half inches in circumference. I do not find notes of attack of the beetle to tree-trunks, nor does it appear to be likely, as the grubs live much in the soft inner part of the bark, and they would not find the nourishment requisite, excepting in comparatively young branches, or where, as in Canon Schmidberger's experiments, the trees were still so small that they were grown in pots.*

PREVENTION AND REMEDY.—Mr. Newstead mentioned that he had advised burning infested trees, and this probably is the very best method of prevention. He also mentioned that as an experiment he had tried painting the bark with a strong mixture of whiting and Paris-green; "but this had little or no effect on the perfect insects; they bored through it and laid their eggs."

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* For various works to which reference is made above, or in which accounts of this infestation will be found, see:—'Praktische Insekten-Kunde,' von Dr. E. L. Taschenberg, part ii. p. 246; 'Injurious Insects,' by Vincent Kollar (Trans.), p. 263; 'Europäischen Borkenkäfer,' von W. Eichhoff, p. 157; and 'Forst-Zoologie,' von Dr. Bernard Altum, iii., "Insecten," 1. Abth. p. 224.

But though the above did not answer, possibly the mixture recommended by Prof. W. Saunders, Director of the Experimental Farm of the Dominion of Canada, and a most excellent authority on economic entomology, for prevention of various kinds of fruit-tree-bark borers, would be found very useful for preventing perforation of the bark for egg-laying when the insects have emerged. This consists of soft-soap reduced to the consistence of a thick paint by the addition of a strong solution of washing-soda in water; "this, if applied to the bark of the tree, especially about the base or collar, and also extended upwards to the crotches, where the main branches have their origin, will cover the whole surface liable to attack, and if applied during the morning of a warm day, will dry in a few hours, and form a tenacious coating not easily dissolved by rain." *

For the special bark-borer attack for which this has been a complete defence, it is recommended to give a coating of the above solution early in June, and a second time early in July, and this date would probably answer as well for defence against our Plum-bark beetles; but at any rate the principle would be the same,—to give a protective wash as soon as the beetles begin to appear, and another somewhat later.

The fact of their emergence being begun may be known by the appearance of little perforations, like small shot-holes, in the bark, and fine dust from the workings of the insect having fallen from them. In the case of the pieces of branches sent me, there was a good deal of this "frass" thrown out.

For special application where it is desired to protect valuable trees from infestation, Dr. Taschenberg recommends the use of Leinweber's mixture. A good recipe for composition of this will be found in Prof. W. R. Fisher's exceedingly useful work on 'Forest Protection' †:—"Five pounds of tobacco mixed with half a pailful of hot water, kept hot for twenty-four hours; the water is then squeezed out of the tobacco, and mixed with half a pailful of bullock's blood, one part of slaked lime, and sixteen parts of cow-dung. This is kept in an open tub, and stirred once a day, and used after fermentation has set in. The rough bark-moss, &c., is trimmed off the tree, and the latter painted with the mixture for three successive days until a crust is formed which the rain will not wash off."

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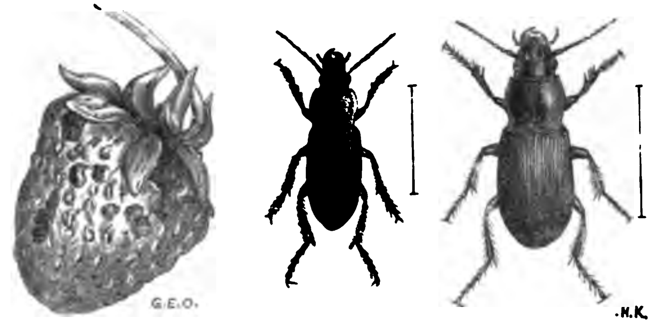
* See 'Insects Injurious to Fruits,' by W. Saunders, F.R.S.C., &c., p. 19.

† 'Forest Protection,' by W. R. Fisher, Assistant Professor of Forestry, Royal Indian Engineering College, Cooper's Hill, &c., p. 250. Bradbury, Agnew & Co., Bouverie Street, London. 1895.

STRAWBERRY.

Ground Beetles. *Harpalus ruficornis*, Fab.; *Pterostichus* (*Omaseus*) *vulgaris*, Linn.; *Pterostichus* (*Steropus*) *madidus*, Fab.



HARPALUS RUFICORNIS (left hand), and PTEROSTICHUS VULGARIS (right hand), magnified, with lines showing nat. length; Strawberry fruit gnawed by *H. ruficornis*.

The attack of "Ground Beetles" to Strawberry fruit, which in 1894 did much mischief at Woodborough, in Nottinghamshire, on the grounds of one Strawberry grower, showed itself again in the past season, and on a much more serious scale. It appeared in many places in the district in great numbers, and attacked the fruit just when it was beginning to ripen, so as to cause serious losses.

The so-called "Ground Beetles" (*Geodephaga*, scientifically) were formerly supposed to be almost entirely of carnivorous habits. There were some exceptions, or partial exceptions, and we owe to the researches of Prof. S. A. Forbes, State Entomologist of Illinois, U.S.A., most of the information (so far as I am aware) which we possess up to date regarding the nature and proportion of vegetable food to be found on dissection and study of contents of many kinds of the predacious Ground Beetles.*

Also the habit of the Corn Ground Beetle, the *Zabrus gibbus*, of feeding in grub state on the roots of corn, and in beetle state on the milky grain in ears of Barley, has long been well known.

But with regard to what may be called straightforward feeding at solid root-crops or fruit, so as to do demonstrable damage by the rood or by the acre, I am not aware of the fact having been recorded until within the last few years, when we have had observation of them on Mangolds in this country, and on Strawberry fruit in this country and in Holland.

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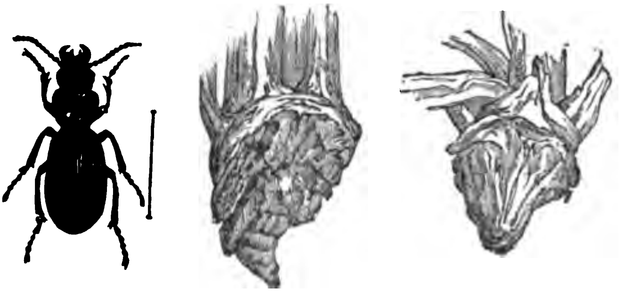
* See Twelfth Report of the State Entomologist of Illinois, U.S.A., for the year 1882, pp. 105–116.

In 1885 I had specimens of the *Pterostichus* (= *Steropus*) *madidus* sent me, by Mr. T. J. Mann, from near Bishop's Stortford (with samples of young Mangold-roots accompanying), as examples of the great damage which was then being done to his crop by the nocturnal, or very early morning attacks, of this beetle to the portion of the Mangolds just about ground-level.



Pterostichus (= Steropus) madidus, magnified, and line showing nat. length; young Mangold-roots gnawed by the beetles.

The above figure is taken from some of the injured Mangolds sent me as "good types of how they were eaten off," and of the kind of beetles (of which samples were also sent) caught early in the morning in the act of eating the Mangolds; and it is added here as the *Steropus madidus* is one of the kinds of Ground Beetles which, both in the past season of 1895 and in the preceding summer, attacked the Strawberries in Lincolnshire.

In 1892 another kind of Ground Beetle, the *Harpalus ruficornis*, was identified by Dr. J. Ritzema Bos, Director of the Phyto-pathological Laboratory, Amsterdam, as being found in great numbers in the Strawberry-beds at Goes, in Zeeland, Holland, and being very hurtful to the ripe fruit.*

In 1894 observations were forwarded to me by Mr. M. J. R. Dunstan, Director of Technical Instruction for the County Council of Nottinghamshire, of attack on Strawberry fruit by Ground Beetles at Woodborough, in the above-named county. The actual berries were attacked by the beetles, who came on them at night in great numbers. The injury was to three roods, and the crop was ruined. The attack was watched, so that there might be no uncertainty as to the cause of the mischief, and samples of the beetles taken proved, on trustworthy entomological identification, to be of three distinct species of Ground Beetles, namely, *Pterostichus* (= *Steropus*) *madidus*, *Harpalus ruficornis*, and *Cala-*

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* See 'Kurze Mitteilungen über Pflanzenkrankheiten und Beschädigungen in den Niederlanden in den Jahren 1892 und 1893,' von Dr. J. Ritzema Bos. Separate impression from 'Zeitschrift für Pflanzenkrankheiten,' iv. Band, 3 und 4 Heft; also 'Biologisches Centralblatt,' xiii. Band, Nr. 7 und 8, pp. 255, 256.

thus cisteloides. For the detailed information placed in my hands regarding this attack, see my 'Eighteenth Annual Report,' pp. 93—97.

In the past season, namely, that of 1895, Ground Beetle attack to the ripe and ripening Strawberries occurred again, not only at Woodborough, but at other places in the district, to a very serious extent, as will be seen by the following notes, and especially by the detailed report of Mr. Rice.

A good supply of the injurious beetles was sent to myself, which enabled me to identify them, and for the sake (in such an important fruit crop matter) of having the opinion of a known entomological expert to rest on besides my own, I submitted specimens to Mr. Oliver E. Janson, F.E.S., who verified my identifications, and pronounced them correct.

These Ground Beetles proved, as before, to be *Harpalus ruficornis*, *Pterostichus* (=*Steropus*) *madidus;* and also *Pterostichus* (*Omaseus*) *vulgaris*, Linn.

Of these, the *Harpalus ruficornis*, Fab. (which was by far the most numerous kind in the consignments sent), is of the shape figured at p. 80; average length six to seven lines; pitchy black; antennæ and legs red or fuscous, rarely black; thorax (fore body) with hinder angles acute, thickly punctured at the base, less so at the other margins; the wing-cases are faintly striated, and clothed with a grey or golden down, and beneath them are ample wings, which they use freely for flight.

For those who have to do practically with these injurious Strawberry Beetles, it would be well worth while to raise the wing-cases, and by spreading the wings folded beneath, to see the size and power of the wings by which they can transport themselves wherever attraction of food may take them.

The *Pterostichus vulgaris*, Linn., is wingless. This beetle (figured, as well as the above, at p. 80) is rather larger than the *H. ruficornis*. It is from six and a half to seven and a half lines, or rather more, in length; the colour entirely black; the fore body rather broader than long, and the hinder angles, though pointed, yet more bluntly so than in *ruficornis;* the wing-cases strongly and smoothly striated.

The *Pterostichus* (=*Steropus*) *madidus*, Fab. (figured, magnified, at p. 81), is (or may be) rather larger than the *vulgaris*, the length running from half-an-inch to over two-thirds. It is wingless and black, though sometimes the legs have red thighs. It is distinguishable from the other species of *Pterostichus* mentioned above by the hinder corners of the fore body being rounded behind so as to be narrower than the base of the wing-cases. For this compare figures at pp. 80 and 81.

The above notes of general appearance give perhaps enough description of three of the four kinds of Ground Beetles found at the Lincolnshire Strawberries for general purposes.

Of the fourth kind, *Calathus cisteloides*, Panz., I did not find any samples in the specimens sent during the past season. This is a good deal smaller than the above-mentioned kinds, being from about a third to half of an inch in length; colour black, with horns and legs brownish-red. It is of the same general shape as the other Ground Beetles; but it may be distinguished to some degree by the fore body being slightly narrowed in front, sinuated behind, and the hinder angles rounded off. The wings abortive, or imperfect.

In Mr. Rice's notes of the infestation, he mentions (p. 85, speaking of the *only kinds* of beetles found) that, besides (1) the brown, and (2) the black (*i. e.*, the *H. ruficornis* and the two species of *Pterostichus*), there was a third kind, which "seemed to be a small edition of No. 1." This I presume to be the *cisteloides*, as its reddish or brownish legs and horns would give it a strong resemblance to the *H. ruficornis* in "small edition," and this species was properly identified as being one of the Strawberry attackers of 1894.

It will be seen in the second report of observations sent by Mr. W. Rice on July 24th (given after that immediately following), that this special beetle, the smallest of the kinds found at the fruit, appeared later on in July in great numbers.

The first information sent me during the past season of the re-appearance of this destructive attack to Strawberry fruit was given in the following letter, written June 23rd by Mr. Joseph Smith, of Woodborough, to Mr. Dunstan, and forwarded on to myself:—"We are having a good crop of Strawberries this year. We worked the land, and used soot and salt, and worked it well in, according to your orders, but we have a large quantity of beetles. They are eating the fruit fearfully this week; the first week was not so bad. We think the pest is worse than last year; and others are suffering quite as much as we are at this present time.

"We have put flesh down, and killed a large quantity in a morning; but they are still very numerous, and we are very anxious to know if there is anything else you can recommend to us."—(J. S.)

On the 3rd of July, Mr. M. J. R. Dunstan, Director of Technical Instruction for the County Council of Notts, wrote me further on the subject, with specimens accompanying:—"I am sending you a tin of the beetles which attacked the Strawberries, a bunch of the attacked fruit, and a report made by Mr. Rice on visiting the field yesterday. . . . There seems an opinion that the beetles appear where the town manure—a general collection of refuse from ashpits, &c.—has been used."—(M. J. R. D.)

Of the beetles sent me, the greater number, somewhere about two dozen, proved to be *Harpalus ruficornis*, five *Pterostichus* (*Omaseus*) *vulgaris*, and one *Pterostichus* (= *Steropus*) *madidus*; for descriptions of which see p. 82.

I give the report of Mr. Rice *in extenso*, as it contains a deal of very useful information, as,—increase of the area affected in 1895 compared with that in which the presence of the beetles was mischievous in 1894; and also the serious amount of injury caused, both to ripe and green fruit. Also some points desirable to be known regarding the habits of the beetles, as,—the method in which they lie sheltered round the plants in the day in vast numbers, and their activity at night; and the clearness of the fruit from other kinds of insect attack, and from the attacks of other kinds of beetles than those mentioned in the report. Also the fact of the beetles being observed in the act of feeding on Strawberry fruit; and also that on some of them being placed in a tin with fresh fruit they settled down at once to the attack. Also various other points useful to know regarding practicable methods of trapping found to answer in lessening numbers; nature of soil, &c. And also two short notes of "local opinions" as to possible cause of this injurious visitation with which Mr. Rice begins his report, both of which are worth consideration, and especially the first regarding "sanitary manure." This being composed of the clearing of ashpits under "sanitary" regulations, from which the manure takes its name, and being consequently a mixture of all kinds of garbage and rubbish (some of which, as meat and fish, I found, in the course of my experiments, these carnivorous beetles would eat eagerly), would be very likely to be an attraction to the beetles, and a centre from which they would spread.

The report of Mr. Rice, made on July 2nd, is as follows:—

"LOCAL OPINIONS.—(1) That beetles came through heavy dressing of sanitary manure. (2) That absence of moles (which have been killed by thousands during the last three or four years) allows the beetles to multiply.

"The only crop affected last year was that of Mr. Smith" [see observations of damage at Woodborough, p. 94 of my 'Eighteenth Report,' ED.]; "but now others are suffering as badly, and in many places the district swarms with them, yet several large growers are not attacked. This year the attack began when the fruit was full-sized, and within three days of ripening.

"A part of a field planted with Strawberries was valued at £10 as they were, but the owner dare not sell for fear of the pest; and a few days after the would-be buyer was called in to see them in ruin, the crop only fetching some thirteen or fourteen shillings as gathered by the owner; while the mass of the other plantings have been left an utter wreck, the whole crop being marked by the beetles.

"The beetles lie round the plant, and under the earth, which is covered with straw and litter, having their holes and runs through the earth and litter; the opening being through the litter and just under the bunch of fruit attacked. The beetles are without number, and seem most active an hour after dark, being full and dormant at break of day, and much deeper in the soil. The beetles are very quick and alert, which makes it very difficult to catch them actually eating the fruit, though some were so found; and beetles supplied with clean untouched Strawberries in a tin settled down at once to the attack, and commenced by taking out the seeds one after another, keeping hold of each for a few seconds. The only beetles were—(1) the brown; (2) the black; and (3) what seemed to be a small edition of No. 1. Also a few of a rusty-red colour, and half the size of No. 1.*

"The Strawberries as a whole are clean from any attack of small insects; only two from hundreds examined having any life on them which could be seen by a small glass, and which seemed like young green fly. The ground was entirely free from grubs, and even next morning, after a hard rain, the number of common snails was not an ordinary average. Some of the large holes in the riper fruit seem as though possibly the common snails had been at them, though the mass of the fruit is free from any injury past that of the outside skin.

"The green fruit is really cleared of its skin, and many of the seeds left. . . . The green Strawberries dry up and wither after an attack, while those riper turn moist and soon rot.†

"The soil is full of soot, and has been also heavily dressed with salt; but where the soot can be seen making the soil black, the beetles are quite at home. The soil under each plant is full of underground channels, and is quite eaten away. The ground seems to have been cultivated when rather stiff and hard, and the humps of soil left, so as to form a ready hiding-place for the beetles which are so numerous.

"The only mole I could hear of was in the field of Strawberries belonging to a man suffering very heavily from the pest, yet he claims where the mole works the fruit is more or less untouched."

(The beetles have been caught by vessels set below the ground-level, into which they fall, and are killed by some destructive mixture). "Also flesh, covered by pieces of thick sacking, attracts a number, which are easily killed; yet both methods do not diminish the vast multitude to any degree."

The following further observations were sent by Mr. W. Rice on

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* For identification of beetles, see p. 82.—Ed.

† Mr. Rice also noted that in the case of the riper fruit the seeds were especially attacked, and lay under the berries as thickly as hail.

July 24th, showing that the severe attack was still continued, with an increased amount of the small kind previously noticed, and some additional details regarding state of ground, *non*-presence of *insectivora*, &c.:—

"NOTES, July 24th.—Beetles still on the Strawberries in vast quantities. A well just dug has the surface of the water entirely covered with the beetles. The small kind, to all appearance a tiny edition of the brown large ones, now swarm everywhere, and seem on the increase. The villagers complain that the beetles now infest their homes." *

With regard to treatment of the ground, Mr. Rice observed:—

"Some of the fields worst affected were dug and left rough round the Strawberries, thus affording an easy shelter for the beetles; while, where the ground in the same fields was left undug after the winter, the Strawberries have escaped the pest. Some of the fields badly infested were not cultivated with town manure, but supplied from piggeries."

Regarding the absence or scarcity of moles and of birds, Mr. Rice remarked:—

"The district as a whole has few moles, and where they are unknown the pest is worse. The whole district has few birds this season through the loss of the past severe winter. Hedgehogs have been tried, but at present the success is unknown. Agricultural salt was largely used, but with no effect."—(W. R.)

From the above observations and careful investigations of the Strawberry growers in the district where the crops were infested by the Ground Beetles on the ripening fruit, there was no doubt of the very serious nature of attack, and the identifications of various skilled and trustworthy entomologists (independently of my own) left no doubt of the beetles causing the devastation being Ground Beetles, *Geodephaga*, that is, of the kinds specified.

But, beyond this, being desirous of watching the method of operations of the beetles, I took the opportunity of the numbers sent me for special observation. Firstly, on July 4th, I put about eight of *H. ruficornis* in a glass jar together with four good-sized ripe Strawberries. On the following morning I found, on examining the Strawberries, that each of the berries had been more or less eaten on the surface. Sometimes the outer surface was destroyed by being gnawed away in patches, and sometimes the injury had gone deeper, and a hollow about a quarter or even half an inch long had been gnawed into the substance of the berry. The absence of the seeds drew attention to where merely superficial mischief had been going on, and in some instances the seeds had been hollowed out, and only part of the husk remained.

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* Regarding the disposition of the *H. ruficornis* to get into houses, John Curtis writes in 'Farm Insects,' at p. 218, of his own observation of them "as abundant in one season in the garden, house, and outhouses"; and when at Fontainebleau, several of the beetles flew to the candles in the evening, "showing they are nocturnal, and provided with ample wings for flight."

For seventeen days, that is, from the 4th to the 21st of July, I continued my observations daily of the attacks of the *ruficornis* on the Strawberry fruit. This fruit I usually renewed every evening, taking care to examine each individual berry before placing it in the jar, so as to be quite certain that there was no insect infestation present, nor any injuries that could be confused with those *caused* by the beetles. Thus I was absolutely certain, so that the extent of the damage could be given by measurement, and figured of the serious amount of damage to the fruit; and also, as I kept the glass-jar containing the beetles, the Strawberries, and about a tablespoonful of carefully examined earth, well tied down over the top, that there was nothing present but the *ruficornis* Ground Beetles to do the damage.

The result of my daily observations, usually taken in the morning and carefully noted in detail, was that the injury was of various kinds to the outer part of the fruit; sometimes little pits, about the eighth of an inch across, were hollowed out, or these pits might be more or less confluent with the surface of the berry damaged between them, so as to form a patch half an inch long. In another berry a quarter of the surface would be gnawed; in another (a fine berry more than an inch long) much of the outside of the fruit was ruined by the beetle-gnawings, which, besides removing the outer part, gave a slimy mashed-up appearance to the fruit from the pulling at it of the strong beetle-mandibles. The state of the attacked part was in great contrast to the unattacked part of the berry, which remained glossy and bright, with the seeds in regular position.

In a few instances the pits gnawed were as much as a quarter of an inch or upwards in length, and from removal of seeds and roughening of portions of the surface, even where worse damage was not done, the selling value of a crop so treated would have been spoilt.

For about twelve days the beetles ate about the same amount daily or rather nightly), and excepting that they appeared to prefer the ripe side of a Strawberry in case the other side was not wholly matured, they appeared to eat without choice of part of the fruit. One of the beetles had died at the beginning of the experiment, presumably injured by handling, and another got away, so that the numbers experimented on throughout in this special jar were six *ruficornis*, which appeared to keep in perfect health on their Strawberry diet throughout; and on the 19th and 20th of July, that is, the fifteenth and sixteenth days of their captivity, I found that they were pairing. After the 21st of July, as, excepting that sometimes the beetles ate less and sometimes more, there appeared to be nothing of further interest to observe, I noted them less carefully.

The result of the seventeen days' careful observation showed that the *H. ruficornis* fed willingly and healthfully on the Strawberry fruit, *and on this food and nothing else* they continued for the time recorded above in their natural state of brisk activity, and also, as observed above, carrying on their natural functions.

After the above date, as it was not so necessary to be certain that there was no other presence in the glass-jar, I gave the beetles a little fresh earth taken from the surface of a garden flower-border, so as to allow them about three-quarters of an inch depth to bury themselves in. This they did willingly, and also partially covered their Strawberries with earth; and on the 27th I found their supplies of berries were so covered with fine earth, that it was impossible to say, from the general wet, "messed" condition, what had been done at any one spot to the fruit; and this attempt at burying suggested that the perishing fruit, which I let remain, and which soon became a mass of mould or fungus-threads, was purposed to be a receptacle for their eggs.

The above notes refer solely to *H. ruficornis* at Strawberry fruit; but on the 26th of July I received about two dozen more of the Strawberry beetles from Mr. Dunstan, of which, on examination, seventeen proved to be further specimens of *H. ruficornis*, and six of *P. vulgaris*. These gave me the opportunity of seeing that it was no peculiarity of the special beetles under examination (no idiosyncrasy, so to say) to eat nothing but Strawberry fruit, but that this, and meat (cooked or raw), fish, bread, live worms, or the parts not too hard for their mandibles to deal with of an insect, were all (apparently equally) acceptable as articles of food. And also that though Strawberries were eaten greedily, they would not, as far as I could see, even taste any of the other kinds of fruit which I placed in their jar.

On arrival, presumably, the beetles were hungry, and I dropped a good-sized rather over-ripe Strawberry among them. This the greater part of the beetles fairly *attacked* at once, those that could not shelter below crowding on the top, and in a very short time they had eaten away much of the outer surface, and deep down into the fruit. Taking the remains away, I dropped two little worms and one fair-sized earthworm, about four or five inches long, into their glass jar, and these were at once attacked. One of the *Pterostichi* seized one of the small worms and, setting its legs firmly, fairly dragged it along; but to the larger worm most of the rest of the beetles made a simultaneous attack. The work was begun in many cases almost as if by an instinctive knowledge of their powers, for small parties settled along the worm with their heads opposite to each other, and thus pulling hard with all their powers against each other with their strong mandibles, they soon tore through the skin. On examination about an hour afterwards, I found that some parts of the worm were not noticeably injured, but much of it was worked away into a mere thread of gnawed shapeless matter. There was no apparent difference in the eating-powers of the two kinds of beetles, and after about two hours and a half they appeared to have had enough; but afterwards, on some fresh Strawberries being given them, some of the beetles went at the fruit immediately.

The savage ferocity with which the beetles ran at their food and tore it to pieces by daylight on being taken from the tin in which they had travelled, was no doubt owing to their long fast, but the method of attack was the same in their ordinary customs. With uncooked meat they would fairly tug at a small piece to detach it, and then walk away to eat it at leisure; and on one occasion I found one of each of the two species of beetles holding on to one piece of meat, and dragging it and each other in all directions in their struggle to possess it.

The daily examination showed they worked at their Strawberries; but all other kinds of fruit which I supplied them with appeared to be totally untouched, neither would they have anything to do with some egg-shell still containing some moisture within. Uncooked mutton they ate greedily, notwithstanding that a slight sprinkling of salt had been given to the joint from which it had been taken; and cooked meat, such as rabbit kidney, or cooked haddock or salmon, appeared quite acceptable. Bread, when given in a rather thin slice, they pierced through with small holes up to about an eighth to three-sixteenths of an inch in diameter. They did not, however, prey upon each other, although they attacked the soft parts of a *Sirex gigas* (the Great Pine Wood Wasp), which had been sent me for identification, and was still fresh.

The above observations I carried on at their somewhat tedious length relatively to the opinion held in the infested districts of the beetle attack being very probably connected with the use of ash-pit clearings for manure, in which all kinds of scraps of animal matter are thrown, and the result, so far as was shown by the small scale on which I was able to experiment, as well as the quantity of beetles attracted by the "pieces of flesh" (see p. 85) placed as traps, appears to point strongly to the probable attraction of what may be called garbage. Once established, the *H. ruficornis*, the brownest of the beetles, which is furnished with powerful wings, and which uses them for flight at night, would spread wherever the presence of the ripe fruit attracted it, and so the beetles would be found at the fruit quite independently of what manure might have been used for the special Strawberry-ground.

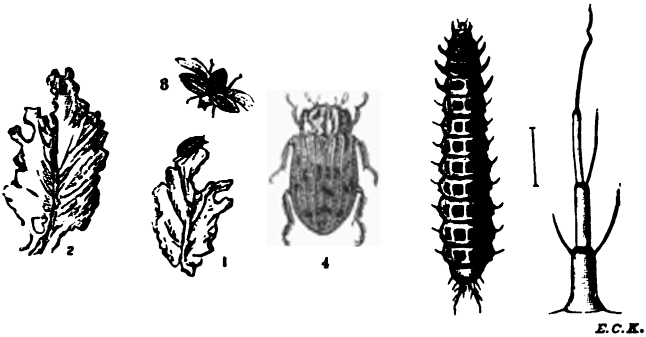
Of the two kinds of *Pterostichi*, having only abortive wings, there would be hope of clearing the ground, or at least of their not spreading unless carried in soil. These (that is, the *P. vulgaris*) were beginning to pair on the 29th of July (the pairing of the *H. ruficornis* had occurred at least nine days earlier), therefore egg-laying might shortly be expected; but though clusters of eggs were reported as seen, it seems open to doubt whether these could be of the Ground Beetles, which would be so small as to be difficult of observation. But later on the grubs would be hatching, which, like those of the Ground Beetles generally, might be expected to be long, parallel-sided, fleshy, and somewhat flat above; the head and first segment hard; the six legs horny; and the tail extremity with two horny or fleshy appendages, somewhat like fleshy bristles, on the upper surface, and beneath to be furnished with a caudal foot.

Whilst these grubs are young and tender some dressing *might* kill them, but the only application which it appears to me would be likely to do this without injuring the Strawberry-plants would be Paris-green, used either in dry or fluid mixtures. A very careful series of experiments have shown that this was not absorbed into the plants experimented on; and there might, I think, be such good hope of it poisoning the young grubs, that it may be worth the trouble of trial.

The only other preventives and remedies appear those of trapping mentioned at p. 85.

TURNIP.

Turnip Mud-beetle. *Helophorus rugosus*, Oliv. = *H. fennicus*, Stephens.



HELOPHORUS RUGOSUS, flying, and on leaf, nat. size; also magnified (after Rye); larva, and one of pair of caudal bristles, magnified. Turnip-leaves gnawed by beetle.

In the past season Turnip attacks have occurred as usual to a greater or less amount, but not on a scale of widespread injury—as in 1881 regarding Flea-beetle, and in 1891 regarding Diamond-back Moths—requiring special record; nor, excepting here and there, as in the case of the application of basic slag as a remedial dressing on leafage infested by the "flea," has there been (so far as I am aware) any new contribution of serviceable information as to methods of prevention and remedy. Therefore I have only noticed in detail the infestation causing damage to the tops of Turnip-bulbs, and injury to growth and edges of leafage, caused by the so-called Turnip Mud-beetle, the *Helophorus rugosus*.

This infestation was first reported from Inverurie, in Aberdeenshire, in 1889, and all the reports since have either been from Aberdeenshire or the immediate neighbourhood. Likewise, until the 28th of Sept., 1894, when specimens of the grubs were also sent me showing their presence as injurious feeders both in the upper part of the Turnip-bulbs and in the leaf-stalks, the reports sent only referred to it in beetle state.

The accompanying figures (magnified and life-size, or with line showing length) are from specimens sent with the injured material, and the beetle was figured from one of several picked from small Turnip-plants, of which *two were in the act of consuming the leaf.*

On September 5th of the past season specimens were sent me by Mr. Robert Ironside, of Auchlossan, Lumphanan, Aberdeenshire, with the following remarks:—"I send you per this post a Turnip, and also specimens of a grub that is doing much harm in a few fields about ten miles from here; . . . the farmer told me that the field would be completely ruined."

The grubs proved to be of the Turnip Mud-beetle (*H. rugosus*), some darker in colour than the others, and apparently about to pupate. The small leaves of the Turnip were much eaten away in some parts; also there were several grubs at the base of the leaves.

From such dates as have been sent with previous samples and reports, it appears that the injury may be found so far established as for attention to be drawn to it, by the diseased appearance of the tops of the plants, as early as the second hoeing of Turnips sown on the 5th of June. On investigation there was nothing wrong at the roots, but on breaking away the unhealthy leaves, the grubs were found sheltered close down where their stems leave the bulb, "and a great many of them in the centre of the shaw, eating up the young growing leaves."

There were sometimes as many as a dozen grubs of different sizes at one shaw, and the description given of the "confined, upright appearance with the edges curled over," which was sent me in one of the most detailed reports in 1894, well describes the external appearance of some of the samples sent.

Besides the above-mentioned injuries, I found, on examining infested Turnip-bulbs sent me much later on in the year (on the 12th of November), that the maggot-burrow was to be found at the top of the Turnip-bulb, running as a roughly-gnawed and uneven gallery mainly round the base of the central growth of leaves. This injury was just under the skin or bark of the bulb, though sometimes it went a little lower; also sometimes it was little more than the width of the maggot, sometimes gnawed to two or three times its width. This necessarily doing harm, both by setting up decay, and checking proper growth of the leafage.

The grubs, when seen magnified, are of the shape figured, and of a pale ground colour, marked with a transverse band of darker tint across the three first segments, and a double row of squarish grey spots along the abdominal segments, with a row of smaller grey spots on each side below. The head is of a chestnut-grey colour, with strong chestnut-coloured jaws. With regard to date of presence of the grubs, as they have been in numbers, and of different sizes, at Turnips sown in the first days of June *at the second hoeing*, and I have had them sent early in September and early in November, there must either be a second brood, or they must be continuing from eggs laid at different dates during the summer.

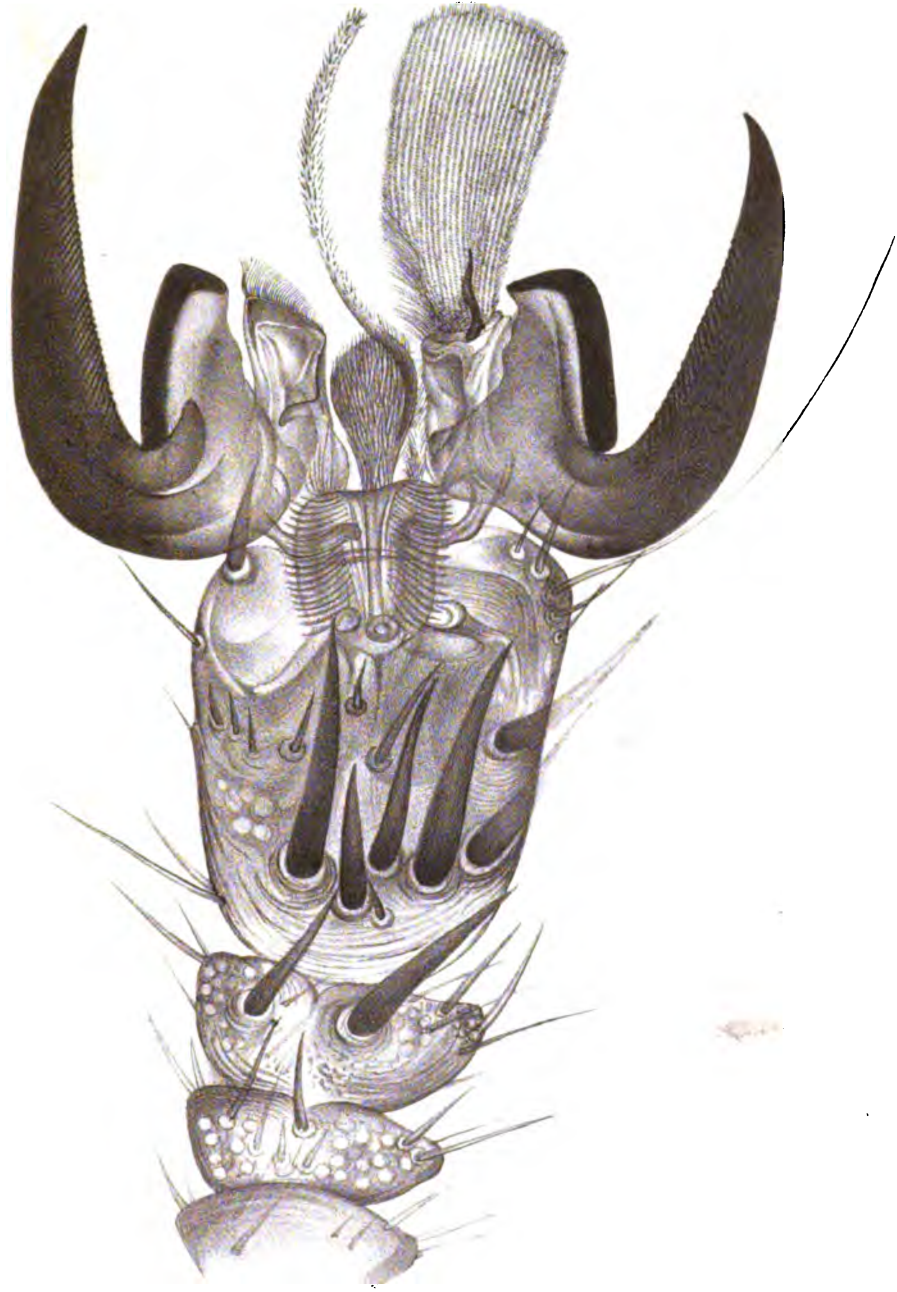
The beetles are of the size figured at p. 91, and marked as shown in the magnified figure. The general colour (when washed free of the clinging dirt, a very necessary operation with this kind of beetle) is rusty or rusty-red; the wing-cases ochrey or greyish, with dark spots. The fore body is marked above (as figured) with various forked or wavy grooves, and the wing-cases are punctate-striate, with the characteristic peculiarity of the spaces between being raised in a clean smooth ridge. The earliest date at which I have received these beetles was, as near as may be, June 26th, but they had been watched at work on the leafage previously; and I have had the beetles, as well as the grubs, sent at the beginning of November.

But what we still need in order to be able to prevent recurrence of the attack is knowledge of where it is that it goes into the chrysalis or pupal state. From the few notes that we have of first observation of the pest, it might be supposed that it hybernated on the infested ground, and came from this to attack the adjacent crop in the following year. In 1889 Mr. John Milne, of Inverurie, who is a thoroughly trustworthy observer, wrote me that he had "observed Turnip-fields attacked at the side next a former Turnip-field here and there throughout this part of the country" [Inverurie, Aberdeenshire, Ed.] "for over thirty years. It is most seen in crofts (small farms) where the lots are in narrow stripes; in some places I have seen the portion of a lot next the last year's Turnip lot quite half-eaten."—(J. R.)

The Helophoridæ, the family of beetles to which this Mud-beetle belongs, are mentioned by Prof. Westwood as often flying "about in the hot sunshine"; so they could easily transport themselves on the wing to where there might be attraction; but still the fact of special infestation occurring on the *specially adjoining* new crop to where the old one suffered, appears to point to the creatures remaining present there, and hybernating either in beetle or chrysalis state.

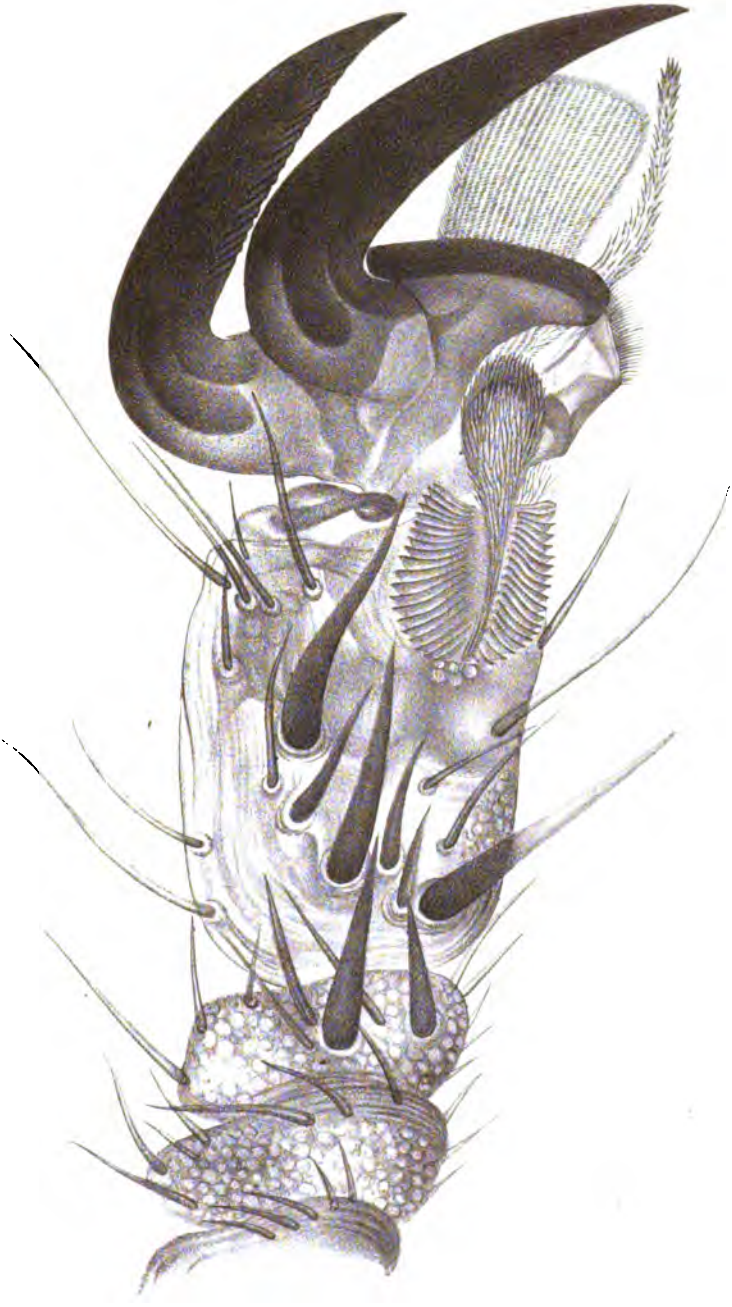
This attack does a good deal of mischief, as noted by Mr. Robert Turnbull, Inspector of Technical Education under the Aberdeen County Council, who wrote me in 1894 regarding the grub attacks:—"They eat the surfaces of the Turnips and leaf-stalks into holes, and also burrow into the leaf-stalks. During the past two years this mode of attack has been very common, and the farmers complain that rain gets into the holes thus made in the tubers, causing decay to set in."—(R. T.)

For the above reason, and also because it appears very likely that a part at least of the unexplained failures in growth of the central leaves of the Turnip might be found if investigated to be due to presence of this infestation, I have drawn attention to it again, although it has been already noticed in my Reports for 1889 and 1894.



Horace Knight ad nat. del. West Newman lith.

Foot of Forest Fly (Hippobosca equina *Linn.*)
Seen from above greatly magnified.



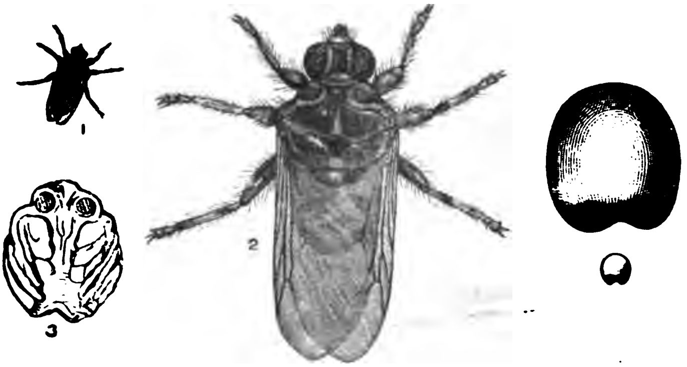
Horace Knight ad nat. del. West, Newman lith.

Foot of Forest Fly (Hippobosca equina, *Linn.*)
Side view greatly magnified.

FLIES INJURIOUS TO HORSES, CATTLE, &c.

1.—**Forest Flies.** Hippoboscidæ.
2.—**Gad Flies.** Tabanidæ.
3.—**Warble Flies.** Œstridæ.

Forest Fly. *Hippobosca equina*, Linn.



Hippobosca equina, 1 and 2, nat. size and magnified from life; 3, pupa removed from egg-like puparium (after Réaumur). Puparium, nat. size and magnified, before complete colouration.

During the past season such an unusual amount of inquiry has been forwarded (with specimens accompanying) regarding attacks of Diptera (two-winged flies) to horses and cattle, that it has seemed most convenient to place these animal attacks by themselves as a second part of the year's Report.

These include notes on Forest Flies, found troublesome to many kinds of animals; also mention of a good many kinds of British Gad Flies (Tabanidæ); and likewise some additional information regarding Warble-attack, especially as affecting red and roe deer, which was kindly contributed, and is now given under the requisite headings.

The Forest Fly (figured above with its wings folded as when at rest) has been brought into more than ordinary notice during the past season, consequently on the New Forest, in Hampshire, which is the especial English locality of this horse and cattle pest, having been chosen as the scene of our autumn military manœuvres. As the fly has generally been considered as only a local trouble, little attention has been given to it in this country beyond the area of the district in which it is mainly to be found; and last year's observations have added something, both to our knowledge of its structure and habits, also of its distribution in this country, as well as regarding preventive measures.

For those unacquainted with the *Hippobosca equina*, our Forest Fly, it may be convenient just to mention, as a kind of general description to begin with, that the fly is about a quarter of an inch long, flat and broad-made, and when in flight appears of a bright shining black. It is a blood-sucker; but the chief annoyance which it causes is by its power of running with great activity backwards, forwards, or side-long, and so irritating the skin, or dragging the hair on the tender parts of the horses, which it especially infests, as to cause such discomfort and terror to animals unused to it, as often leads to great inconvenience, sometimes to serious accidents. Also it has the great peculiarity of only existing *actively* in fly state. It is produced not as an egg or ordinary maggot, but in a condition answering externally to the pupal stage, whence the division to which this fly belongs takes the name of *Pupipara*.

LOCALITIES.—In this country the Forest Fly is most especially to be found in the New Forest, in Hampshire, or in the vicinity, where it may have been conveyed on infested animals. In the first notice with which I am acquainted of observation of the *H. equina* as a horse and cattle pest in this country, which was given by Jean Barbut in 1781, in his work on English examples of the Linnæan genera,* he mentions, p. 319, that he has received these insects from the New Forest, where they are to be found in great numbers.

More recently various localities have been named, mainly in the south of England, where the Forest Fly has been considered to have been observed; but the only other place where I have certain personal knowledge of it being found in this country was during the past summer on coach-horses at Beddgelert, in North Wales.

In consequence of some correspondence then taking place as to localities in which Forest Fly was to be found, inquiries were sent by the editor of the 'Veterinary Record' to all the members of the Royal College of Veterinary Surgeons in Carnarvonshire, and on June 26th three specimens were sent by Mr. Morris Williams, of Pwllheli, which I found to be quite certainly of the *H. equina*, Linn., commonly known as the Forest Fly. Of these Mr. Morris Williams wrote as follows †:—

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* 'Genres des Insectes de Linné, constatés par divers échantillons d'insectes d'Angleterre.' A Londres, MDCCLXXXI.

† See number of 'Veterinary Record' for July 6th, 1895, to the editor of which I offer my best thanks, both for use of the information, and for a sight of the specimens.—E. A. O.

"I have made further enquiries, and find that they are only seen in the district from the beginning of June to the middle of September.

"The neighbourhood from which they come is a wide valley running from Portmadoc to Beddgelert at the foot of Snowdon. Ponies are kept on the mountains on both sides in the summer, as well as a herd of ponies that are on the lowland both summer and winter. The village of Beddgelert being eight miles (without railway) from Portmadoc, and also being the nearest ascent to Snowdon, the horse traffic is very great along the road which runs under the mountain, especially in the summer season.

"These flies were captured on one of the coach-horses on the above route by Joseph Davies, coach-driver, Prince Llewelyn Hotel, Beddgelert."—W. Morris Williams, Pwlheli, June 26th, 1895.

The presence of the Forest Fly at such a great distance from its special habitat appears to be of a good deal of practical interest, as its unsuspected infestation in other localities might prove to be the cause of sudden unaccountable unruliness, sometimes causing a deal of trouble.

DESCRIPTION OF THE FLY.—The Forest Fly (*Hippobosca equina*, Linn., scientifically) is known also as the "Spider Fly," from its spider-like appearance when the abdomen is distended by the single embryo; also as the "Flat Fly," from its flattened appearance under other circumstances; and also sometimes as the Horse Louse; locally, in the New Forest, the flies are often known as "Foresters."

The length of the fly from head to tip of tail is about a quarter of an inch; total length, including wings when laid flat along the back, three-eighths of an inch; the shape flattish; and the skin in great part so hard and leathery as to be difficult to crush. The general colour above deep shining brown, somewhat mottled with tawny-yellow.

Head shining, rounded, flattened before, tawny-yellow, with a dark stripe down the middle of the face. Compound eyes dark and very large, occupying the whole sides of the head; *ocelli*, or "simple eyes," none; antennæ very short and sunk in pits, the end joint round, and bearing a long terminal bristle, and a shorter and smaller one.

The mouth parts consist externally of a narrow proboscis-like apparatus, pitchy or blackish; this is composed of two pieces which have a power of separation, but when applied one against the other form, by their concave inner surfaces placed together, a sheath, or elongate case, for the true trunk, or sucking-tube, which the insect can lengthen or withdraw at pleasure, and which to moderately powerful microscopic observation looks like a long yellowish somewhat horny or membranous thread, capable of great extension, and also very flexible at the extremity.*

The thorax (*or body between the wings*) slanting off at the shoulders, which have each a large patch or irregular ring of tawny-yellow above, with more or less of the brown ground colour in the centre, some small pale markings along the middle of the hinder part of the thorax, and a pale spot in the centre of the scutellum (that is, of the small portion of the upper part of the thorax just preceding the abdomen).†

Abdomen brown, grey below, and, like most of the fly, more or less beset with bristly hairs.

Wings two, strong and membranous, slightly opaque and brownish in colour, and furnished with several strong dark veins placed along the front portion of the wing, as exactly figured from life at p. 95. The *halteres*, or poisers, of moderate length, and with a thickened head, but not noticeable without removal of the abdomen.

Legs rather long (when extended flatly in horizontal movement of the insect they appear very long); of great strength; colours tawny-yellow, clouded or ringed with brown or black; the thighs mostly brown, with a ring of tawny near the extremity; and the two posterior pairs of shanks mostly tawny-yellowish in the middle, with a ring of brown at each extremity.

Each foot (or *tarsus*) is terminated by a pair of claws, and each of the pair is formed of one large, very strong, much curved, black claw, at the outside of which is placed another much shorter and thicker, forming a kind of thumb-like appendage to the main claw. On placing the curved claw in a good light, I found that the lower parts of the sides were furrowed by minute grooves placed parallel to each other, also that the lowest part of the claw had running beneath it a regularly serrated or scalloped edge, each groove running down to a notch in the saw-like edge (see Plates, and also following figure). Thus, when the fly exercises its power of pressing the sides of the curved claws together, they form a pair of flat-sided forceps, than which nothing could be more perfectly adapted for holding fine objects, like the hairs, amongst which the presence of this fly causes such well-known discomfort, or even terror.

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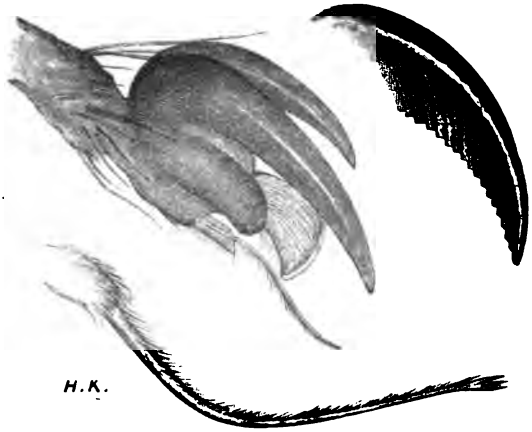
* The number of *setæ* of which this trunk is composed is differently given by various investigators. Latreille gave it as two, Duges as four, and Prof. Westwood as three; for detailed account see 'Classification of Insects,' by Prof. Westwood, vol. ii. pp. 582, 583. In my own observations it has appeared to me that the great power of sweeping surfaces possessed by the flexible end of the trunk pointed to possible drawing-in of fluid for food from the surface of the skin of infested animals, as well as from beneath it, and may (if examined into) confirm the popular belief of the Forest Flies imbibing skin perspiration as well as sucking blood.—E. A. O.

† The presence of the single pale spot on the scutellum is one of the especial differences between the *H. equina*, Linn., and the *H. canina*, Rondani. See 'Muscaris Exotica Musei Civici Januensis,' by Prof. C. Rondani, Annali del Mus. Civ. di Sc. Nat. di Genova, vol. xii. p. 164.

This file-sided and saw-edged structure of the large curved claw is to be found in our *H. equina* (see Plates). I have also found it in the *H. maculata*, Leach, the Indian Forest Fly (see figure accompanying of portion of claw much magnified), and presumably is to be found in the case of other species; but in observation I could only get a satisfactory view of the parallel grooves by examining the claw in natural condition, dry, and as an opaque object, and also with a bright side light. In this way the clear lines of alternating light and shadow showed the ridges and furrows excellently, but in Canada balsam I was not able to distinguish them.



Foot of *Hippobosca equina*, showing double claws, central process, and long prickly bristle; also portion of side of claw of *H. maculata* (also magnified), showing parallel grooves and saw-edge.

The long bristle-like appendage, originating beneath the foot, and extending fully to the length of the curved claws (see figure and Plates), the "*poil barbu*," or bearded hair—first, I believe, noticed by De Geer in his 'Mémoires' on *Hippobosca*—was very noticeable. In these observations, besides other structural details, he notes the existence of this foot appendage of a bearded hair, "*poil à barbes*," referring the reader for details to p. 288 of the same paper (referred to below), where, under the heading of "*Hippobosque verd*"—the *Hippobosca* (now *Ornithomyia*) *avicularia*, Linn., the Spider or Forest Fly infesting birds—he describes the appendage thus:—"Between the '*pelottes*'" [pads or pulvilli, Ed.] "there is placed a very remarkable bearded hair, having bristles at each side like a little feather, which is attached beneath the foot. We have already mentioned that the *Hippobosca* have a similar hair appended to their tarsi."—(C. De G.)

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* See 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer, vol. vi. p. 279. Stockholm, MDCCLXXVI.

This appendage is figured *in situ*, Plate 16, fig. 27, of the volume above quoted, and there shows plainly as a hair, or rather bristle, very much bearded with side hairs and placed between the pads ("*pelottes*"), which are widely expanded to show it, and projecting beyond them for about half their length.

The appearance of this hairy bristle I found to differ greatly according to it being viewed in natural condition or in balsam. In the latter, instead of the whole length of the many hairs placed along the bristle being visible, only the lower portion was clearly noticeable, this giving the bristle itself the appearance of being set with short spines. The terminal extremity appeared to be not pointed, but ending in about five spines, or moderately sharp spine-like tubercles (see Plates).

This hairy bristle is also shown, but only enough magnified to give a general idea of its structure, in the figure of the foot of *O. avicularia* in Walker's 'Insecta Britannica (Diptera),' vol. ii. pl. xx. fig. 8*b*, after a drawing by Prof. Westwood. Also Dr. Schiner, in his description of the characteristics of the genus *Ornithomyia*, mentions this appendage of the foot as projecting like a thread, and slender, but also beset with hair.*

In the course of attention that was directed to the subject of Forest Fly in the columns of the 'Field,' and also of the 'Veterinary Record,' some notes were given from his own personal microscopical observations of the existence of this "bearded hair" as a foot appendage both of the Forest Fly and of the "Sheep Tick" (*M. ovinus*) by Mr. Thos. B. Goodall, F.R.C.V.S., with figures accompanying, in the 'Veterinary Record' for May 25th, 1895, p. 686. Mr. Goodall observed:—"In addition to two strong mailed claws there is a plume-shaped body situated between the cushions, or pulvilli, beneath the feet, and extending to the length of the claws. The same organ may be observed in the *Melophagus ovinus*, or Sheep Tick (which, however, is no tick, but a wingless fly). In the latter, however, it is more feather-shaped than in the Forest Fly, being, in this insect, tubular, and covered with hair-like scales."—(T. B. G.)

In the exigencies of newspaper printing, the delicacy of representation necessary for showing minute differences of structure can hardly be attained, but the presence of a hairy bristle is very obvious.

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* ". . . das *Empodium* ragt fadenformig vor, und ist oben zart, aber dicht behaart."—See 'Fauna Austriaca: die Fliegen,' von Dr. J. R. Schiner, ii. Theil, p. 646; and at p. 649 of the same work Dr. Schiner mentions regarding the *Melophagus ovinus* (our so-called Sheep Tick), "Haft-lappchen" [that is, pads or pulvilli, Ed.] "und *Empodium* deutlich"; but, beyond their being "observable," does not give description.

In the course of my own observations of method of progression of the fly, I noticed what appeared to be a great peculiarity in its method of adhesion to vertical surfaces, and on minute examination such a complicated structure of the lower portion of the foot, that, as I was unable to find description of this in works to which I had access, I took the opportunity of having the foot figured so as to give all the details clearly, excepting that the structure being so thin and transparent that it was easily pressed somewhat from its right position by the covering glass of the slides. Therefore the figures are taken (respectively) both from above and as a side-view to show the position of the various parts clearly.

On watching the procedure of the Forest Flies when confined in a small cardboard box with upright sides, and a glass cover which allowed of observation of their movements through hand-magnifiers up to two-inch focal power, I could not perceive that they made any use of their strong curved claws to help them in the ascent of the vertical sides. Where I could gain a good view, the claws were thrown up so as to be clear of any attachment at all, and the fly progressed upwards, apparently holding on by the thick basal part only. The position would be precisely shown by placing the wrist (in our own case) firmly down on any flat substance and raising the hand and fingers at an obtuse angle; and on investigation I found a small appendage, which, when properly displayed, proved to be the thin broad membrane, with plume-like channels or ridges, curving from each side of a central vein or tube, and with a bulb thickly covered with what appear to be short hairs, which is figured in the two Plates.

In the view from above, this flap and bulb are in their correct central positions; in the other they are pressed to one side; but the connection between the flat plume-like flap and the bulb are clearly given, as also what appear to be several openings (circular orifices) at the summit of the central (?) tube.

The general appearance of this plume-like broad membrane will be seen at first glance to bear a most marked resemblance to the flexible lobes, known as *labellæ*, which form the terminal portion of the proboscis of the Blue-bottle Fly.*

Of this (the flexible lobes), the author of the work remarks at p. 192:—"These will of course be closed up like the leaves of a book, and not opened out as seen in the photograph. . . . Each lobe contains about thirty channels, some of which spring from an inner marginal tube on each side, and all are open to the air by a narrow groove along the under surface." Details are given at some length by Mr. Butler, amongst other points, of the structure of these tubes, "which," he says, "on account of their superficial resemblance to tracheal tubes, are called *pseudo-tracheæ*. . . . They are, of course, not breathing-organs, but serve as a sucking and straining apparatus for conveying to the mouth the juices on which the fly feeds."—(*Loc. cit.* p. 193.)

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* See figure, much magnified, given in 'Our Household Insects,' by Edw. A. Butler, B.A., B.Sc., plate ii.

This, in respect of feeding, would not be the use in the case of foot service of the Forest Fly, but a "straining apparatus" would be exceedingly appropriate so placed; and I have ventured to draw attention to them, as though I fear I may be merely speculating on the uses of apparatus well known to skilled dipterists, yet, if so, I will ask excuse, as I have not been able to find description of the appendages; and in any case the figures of the wonderfully delicate foot-apparatus which enables the Forest Fly to make itself so thoroughly at home on its hosts will be of interest to many.

Perhaps I may add that the microscopic slides were prepared for me from quite fresh specimens by Mr. J. Pillischer (optician), of 88, New Bond Street, London; and the figures—which I think are very beautifully executed—were drawn for me by Mr. Horace Knight, of the artistic staff of Messrs. West, Newman & Co., 54, Hatton Garden, London.

HABITS OF THE FOREST FLY.—The following notes, sent me on the 2nd of May by Mr. Thomas B. Goodall, F.R.C.V.S., of Purewell Cross, Christchurch, Hants, were among the first communications with which I was favoured in the past season on the habits of the Forest Fly.

Mr. Goodall observed that "horses bred in the forest take no notice of it, though, strange to say, the donkey will never tolerate its presence, but will use the most frantic efforts to dislodge the fly.

"Most strange horses become accustomed to it in a few days; but some never do. I have an old cob (now a pensioner) that I brought here from Leicestershire twenty years ago, and even now a Forest Fly crawling over him will drive him almost mad.

"I do not believe that it is the cause of any direct harm to the horse, though it does take its nourishment of blood from its host.

"A strange horse is frightened because of his inability to dislodge the fly, its power of prehension being so great that the horse's tail is powerless to remove it, and it crawls over the body of the horse, and does not remain quiescent until it finds a thin part of the skin, where, in the Forest ponies, it may sometimes be seen in clusters. The favourite parts being round the anus, on the perinæum, and on the inner parts of the thighs.

"When a strange horse has a 'Forester' (as this fly is called locally) on him, he shows symptoms which at once tell us, who have experience in the matter, what ails him. He has a frightened look, lays his ears back, and makes short stamps and kicks with his feet; and if the fly is not taken from him, he will sometimes sweat profusely, kick violently, and even roll.

"I do not think the fly ever goes into a stable of its own accord; and if the horse is freed from them before going into the stable, he is safe from attack until he is taken out again. The custom here is to search the horse well all over, particularly in the fly's favourite haunts, before he is taken into the stable, after being in the 'fly' district, which is the New Forest, for *we never find them away from the Forest*, unless they are taken by horses.

"As you may imagine, there is some danger to one unaccustomed to the habits of the fly, and also of the horse, in attempting to dislodge the fly. It will, when disturbed, make short flights from one part of the body to another, and then *run*, generally sideways. Strangers will sometimes endeavour to knock it off, like an ordinary fly, which is useless, and increases the irritation of the horse.

"The *only* method is to clap the hand or fingers *flatly over the fly*, and then remove it; and it is killed by pressing the thumb-nail into the thorax lengthways.

"I really know of no specific for preventing attack, though wiping the horse over with a paraffin rag renders him less inviting to the fly; but when we know that it may settle on any part of the body, it will readily be seen how inconvenient it would be to do this often or daily, and (as I have already said) we here simply catch and kill the fly, and take no further notice of it.

"It has been erroneously stated that the fly has a strong flight; this is not so. It only uses the wings to reach its host, or to take a short flight from one animal to another, or from one part to another of the animal on which it first alights.

"When at rest on the body of the horse, *one wing overlaps the other*. . . . I have heard it said that the wings are deflexed, which is incorrect."—(T. B. G.)

Writing to me on May 10th on the above subject, Mr. Goodall observed: "The Forest Flies are out again now, and are as plentiful as the Blue-bottle"; and on the 29th of May, in reply to a request of mine for some specimens, he noted: "They are not so much in evidence since the advent of this cold weather." Shortly after he favoured me with a good supply.

The following notes are from observations with which I was favoured by Mr. D. D. Gibb, of Ossemsley Manor Farm, Lymington, Hants, with specimens of the Forest Flies sent accompanying from time to time, which enabled me to study their structure, and to some degree their habits. On the 8th of May Mr. Gibb wrote: "I find the New Forest Flies are now fairly plentiful, the warm sunshine having brought them out from the sheltered haunts, and under the bark of old trees, where they hybernate."

In regard to their powers of annoyance, and especially by clinging to hair, Mr. Gibb remarked:—"All owners of horses who have been for any length of time in the neighbourhood of the New Forest are familiar with the pest. The body is tough, like india-rubber; with its toothed claws it can retain a very tenacious hold of the hairs of animals, and when pulled, so tight is its grip, the outer sheath of a hair will be seen to peel like the bark off a twig.* No slight rub, or switch from an animal's tail, will therefore dislodge it, or drive it away. This may set it in motion, when it may fly to another part, or cause increased irritation by running about. The movements are quick and somewhat crab-like, which tickle sensitive animals.

"When first some horses make its acquaintance they are very restive, and frequently become unmanageable; donkeys will sometimes roll and kick for an hour in their endeavour to get rid of the fly. On the wild ponies (and cattle) which run in the Forest these flies are frequently to be seen in clusters like bees."

In regard to the method of feeding of the Forest Flies by blood-sucking, Mr. Gibb mentioned that he had closely watched them on a young Arabian pony turned out to grass on the edge of the Forest, and had taken them *in the act.* The skin was very clean, so that nothing else could be found, and when examined blood was found. Yet the bite seems less irritating, as the animal was not much disturbed by the flies when sucking blood. And in another letter Mr. Gibb also mentioned regarding the above points:—"It will take blood, as I have frequently killed flies containing the same, and fully distended by the quantity they had taken. Yet I believe most flies examined will be found without. And animals do not seem to mind the presence of these flies so long as they remain at rest.

"On cattle running in the Forest, flies are to be seen in clusters numbering many hundreds without the animals feeling disturbed. The parts where these flies congregate do not become tender, so their bite must be of a mild form, else I think cattle could never become so reconciled to their presence."

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* This power of the *Hippobosca* of splitting the hairs to which it adheres will be found mentioned in the number of the 'Field' for August 3rd, 1895, p. 219, by a correspondent writing from Cachar, India. In this it is mentioned:—"I have often amused myself by grasping the fly by the wings between finger and thumb, then allowing it to catch the hair on the back of my other hand. So sharp is the claw, that the hair grasped by it is cut to shavings like wood by a carpenter's plane."—(J. B. D.)

That the Forest Flies are blood-suckers is a fact which has long been proved; but still it appears to me open to doubt whether it does not also draw in the moisture of the skin through its sucking-tube. There is a strong popular idea that it does so, and the fact noticed by Mr. D. D. Gibb, that it is by no means always that blood is to be found within (on opening the fly), appears at least to point in the above direction. In the course of my own observations I found that some of the flies which I kept in confinement swept to and fro with the flexible extremity of the trunk on the part of the cardboard which I had slightly wetted, as if they were trying to imbibe the moisture. This point would, I think, be worth enquiry for practical purposes.

Reverting to Mr. Gibb's letters regarding methods of prevention, he mentioned:—

"Well-groomed horses afford least attractions for these flies. *The common remedy* adopted by those driving in the Forest with an unseasoned horse is to damp a cloth with paraffin, and rub lightly over the animal, particularly the parts beneath and under the tail, which are most subject to attack. For some years I have used, with excellent results, a carbolic sanitary fluid prepared by Mr. Johns (chemist), High Street, Southampton, which is clean and far from offensive in use, and effectual in keeping off Forest Flies. When added to hot water it mixes very readily, giving the water a milky appearance. For dressing, or rubbing over with a wet cloth, two tablespoonfuls to a gallon of water would be sufficient. To wash animals over, if desired, one pint to twelve gallons of water would be the quantities. Doubtless McDougall's or Jeyes' preparations would serve the same purpose. Train-oil is a very old remedy with natives of the Forest, but it is offensive and dirty."

The following practical remarks as to accustoming horses to attack were given me by Mr. Moens, of Tweed, Lymington, Hants. On the 1st of June, Mr. Moens wrote:—"With horses strange to the Forest Fly we put some flies on them and, seeing that their head-gear is good, let them kick themselves until tired in the stalls. After a short time we find horses get used to them, but some never will. When the flies trouble them much, the thing is to keep the horses going fast, so as to get very hot, as the flies do not care for this *; the worst thing is to stop them, unless one stray fly is on the flank, when it is easily caught with a clap of the open hand."

LIFE-HISTORY OF THE FOREST FLY, *H. equina*.—The important part in the life-history of this fly is that, like others of the division of the

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* Conjecturally, because the perspiration amongst the hair keeps them from moving about freely, and also clogs the fine apparatus of their feet. See Plates.

Pupipara to which it belongs, the egg is hatched, and the maggot (or *larva*) feeds and is nourished up to maturity within the abdomen of the parent fly. When fully developed this larva is deposited not as an ordinary maggot, but as a *puparium*, or pupa-case, within which the larva is then completing its immediate change to the pupal or chrysalis state, and from which puparium the perfect fly emerges, it may be in about a month, or it may be after a much longer period, according to weather and other circumstances.

Thus the Forest Fly never exists *actively* on the infested animals excepting in *imago* (that is to say, in fly) state. It cannot be called *oviparous*, as assuredly it does not lay an egg, and as although it is considered that the fully developed larva, or maggot, has not turned to the pupal state within its case at the *moment* of deposit, yet this change takes place so almost immediately, and the change *externally* by which the "case" hardens and otherwise assumes all ordinary characteristics of a *puparium* also occurs in such a few hours, that the name of *Pupipara*, or "pupa-bearing," was bestowed on this division of *Diptera*, or "two-winged" flies, by Latreille, and continues to be still their distinctive appellation.

In the course of the hundred and fifty-six years which have elapsed since the discovery was first made by Réaumur of the true nature of the egg-like body deposited by the Forest Fly, an enormous amount of attention has been given to the *internal* embryological development, but still the *external* conditions, although well known by technical observers, are by no means as generally known as they need to be for practical use; as, for instance, the egg-like *puparium* is still often believed (before it has coloured) to be an egg, and afterwards to be in some way connected with presence of Ticks. Therefore in the following pages some amount of detail, which may be of interest, as to the points in the life-history of the Forest Fly which practically concern ourselves are given, with references quoted to the original authorities, and also a list of works consulted is appended, where those who desire to enter on the early internal development (the "embryology") of this and various other species of the *Pupipara* will find full microscopical details.

The first discovery of the method of propagation of the *H. equina*, being by deposit of the egg-like body which proved to be really the *puparium*, was made by Réaumur in the middle of the month of October, 1739. But the season being then too late to continue investigations, it was not until September 18th in the following year, 1740, that he was able to continue them (*and to this day his observations on this part of the history leave nothing to be desired either for clearness or accuracy*).

Then he again found the egg-like body, of which the history was then unknown, deposited by the *H. equina*, and to secure (as far as possible) temperature and circumstances in which this, the first of many puparia subsequently experimented on, might be successfully developed, he placed the "egg" (?) in cotton in a bottle safely corked up. This he carried by day in his pocket, by night it rested under his pillow, and after thus carefully treating it for nearly a month he witnessed the development. "It was not until the 17th of October that I saw the egg open, and I found *not* an insect which had to grow and to undergo transformations; but a fly in all points similar to that by which the egg had been laid, and of which all the parts were of equal dimensions with the dimensions of the parts of that by which the egg had been produced.*

"The egg-like body" [that is, what proved to be the puparium, Ed.] "when deposited was white, with the exception of the two projections at one end, the space between them, and some amount of the parts in the vicinity of the notch" [for shape, see figure, p. 95, Ed.]; "the envelope hard and firm, and becoming still more so as it changed to a brown colour, and thence in about twenty hours to a shining black, when it could resist a considerable pressure."—*Loc. cit.* p. 588.

The next point in investigation was to trace out the method and progress of development of the fly in the *puparium*, and the first step was opening one of the egg-like bodies which had been deposited four days later than that from which the *H. equina* had been seen to emerge, and in this, not quite developed (that is, still in pupal state), the Forest Fly was observable (see figure 8, p. 95).†

The compound eyes ("*yeux à réseau*," or reticulated eyes) were already of a reddish colour, and so also were the two external mouth-processes, which together form the sheath of the trunk. The rest of the pupa was white, excepting some tufts of greyish hairs; and the hinder extremity of the pupa, or "nymph" (as it was then called), was placed against the notched hinder extremity of the puparium, with which, as will be seen on reference to the figures at p. 95, it corresponds in the shape of its own notched or heart-shaped end.

To trace the history in its entirety, Réaumur opened specimens of the egg-like puparia at different dates after deposit by the female *Hippobosca*, as of three weeks, ten, five, four, three days, and one day

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* 'Mémoires pour servir à l'histoire des Insectes,' par M. de Réaumur. Paris, MDCCLII. Tome sixième. Quatorzième mémoire, p. 580.

† This figure is copied from figure 21, plate 48, of Réaumur's illustrations accompanying his paper previously cited, and (as pointed out by the late Professor Westwood) it is much to be regretted that this plate is so little known. It contains twenty-three figures showing the *H. equina* in its various conditions, with numerous details, presumably from other observations made by M. de Réaumur in the same paper, figured with a magnifier of rather more power than half-inch focus.

after deposit, and also by opening the abdomen of various of the female flies at different dates before deposit,—that is to say, when the abdomen had reached various degrees of enlargement.

Thus he traced the pupal presence in the *puparium* back to the condition of "*bouillie blanchâtre*," or whitish pulp, of which the microscopic powers of those days (in the case of the power used by Réaumur rather stronger than half-inch focus) were not sufficient to give the minutiæ of formation; also he traced back through its immediately earlier stages the presence of the white body presently to be deposited.

His memoir on the *H. equina* is well worth studying, not only on account of the sound information given by the writer, which stands to this day as the original authority of much of what is most useful to us practically in our knowledge of this horse pest, but as an example of careful working forward of the matter under observation, and, where uncertainty arose, simply giving an exact description of what he saw, but leaving its nature as a subject for further investigation.

Following on the same ground, and desiring (to use his own words) to verify for himself the admirable observations of his precursor, the well-known entomologist De Geer, on the 28th of July, 1770, commenced a similar series of investigations, which, with their confirmation of Réaumur's records, discussions of involved points, and some additions, as well as observations on the allied genus the *Ornithomyia*, will be found as referred to below.*

Taking the main points of the development of the *Pupipara* within the abdomen of the female, it appears that the life-history may be shortly stated as follows.

The young maggots (larvæ) develop, in the same way as those of other insects, from a fertilized egg; only in this case the hatching takes place inside the female, instead of after the egg has been laid. In the case of the Sheep Tick, or Spider Fly (the *Melophagus ovinus*), the egg is stated by Leuckart to be of a long and rather slender shape, the greatest length being somewhat over one millimètre (that is, the twenty-fifth part of an inch), and the breadth rather over half a millimètre.

The abdomen is covered with a continuous membrane capable of great distension, which occurs in the females by reason of the larva feeding and growing within; this feeding being stated to be carried on by swallowing the secretion of large glandular appendages of the uterus. When full-fed the larva, of which there is only one (although the females are furnished with a pair of remarkable ovaries), is deposited in the shape of a soft whitish egg-like body (which answers to the ordinary fly chrysalis-case, or puparium); the larva immediately on deposit completing its change from the fully developed state in which it was produced to the pupal state, and its case so rapidly changing in external character, that in twenty-four hours or less, in the case of the Forest Fly, the soft whitish body has changed to the brown or black colour and the hard exterior of the perfect pupa-case, from which the perfect fly emerges, by cracking off one end of its case, in about four weeks. In the instance especially watched by Réaumur, the time occupied was from the 18th of September to the 18th of October*; but it is considered that hybernation sometimes takes place in pupal state.

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* 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer. Stockholm, MDCCLXXVI. Tome sixième, vi. Mém.

The above gives to the best of my power just so much of the main points of the life-history of the *Pupipara* as may be needed for common purposes, digested from the works of the chief writers on the subject, including amongst these the observations of our own eminent entomologist, the late Prof. Westwood, which are not only valuable in themselves, but also as giving references to the chief authorities on the subject up to date. Likewise information from Dr. Leuckart's work on the *Pupipara*, which, to those who can find time to work through the eighty-two quarto pages of minute record of profound personal research, with confirmation or correction which he considered called for of previous observations, is invaluable to students of the propagation and development of the *Pupipara*.†

Dr. J. R. Schiner places the matter of the puparial deposit of the Hippoboscidæ very plainly in a few words:—"The females instead of eggs lay immediately fully-formed pupæ, whence these and all the genera of this family are called *Pupipara*." ‡

Those who wish for convenient digests of the subject for practical as well as scientific purposes will find it usefully noticed in Neumann's 'Parasites, and Parasitic Diseases of Animals,' translated and edited by Dr. Fleming, pp. 86–88; and also with life-histories, &c., of some of the special stock infestations, in Dr. Taschenberg's 'Praktische Insekten-Kunde,' pt. iv. pp. 168–178; as well as in standard works on entomology or economic entomology too numerous to quote, but of some of which I give the titles in the list appended under the heading of "Bibliographical References" (immediately preceding the Index).

To these should be added reference to the work of M. Léon Dufour, published in 1845,* embodying his own minute observations of organisation, and more especially visceral organisation, of the *Pupipara* as especially studied by him in the *Hippobosca equina* (Forest Fly), the *Melophagus ovinus* (Sheep Tick or Spider Fly), and also the *Ornithomyia viridis* (Bird Spider Fly). In the latter part of this treatise (pp. 73–98) M. Dufour enters on minute detail of structure and embryological conditions relatively to method of propagation, which he considered to prove that from the first dawn of existence neither egg nor larva was to be found, but that the early development and method of nutrition resembled that of the Mammalia. Therefore he considered that, instead of the usual entomological terms for the stages of life preceding the pupal states, it would be more correct to use the words "embryo" and "fœtus."

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* Réaumur, *loc. cit.* p. 580.

† For above references see 'Classification of Insects,' by Prof. J. O. Westwood, vol. ii. pp. 580–587; and 'Die Fortpflanzung und Entwicklung der Pupiparen nach Beobachtung an *Melophagus ovinus*,' von Dr. Rud. Leuckart. Halle.

‡ 'Fauna Austriaca: die Fliegen,' by Dr. J. R. Schiner (Fam. Hippoboscidæ), vol. ii. p. 644.

This view of development attracted great attention at the time, and likewise contradiction; but those who care to go into the subject will find much of what may be called *useful straightforward* information regarding both external and internal structure of the three species of *Pupipara* above referred to, in the earlier pages of the treatise. And to those who care to study his minute embryological descriptions, accompanying them with perusal of Leuckart's quarto as a commentary on the points in which he considered Dufour was in error,—and also how in the main point on which Dufour based his view of mammalian development this eminent entomologist was correct as to what he saw, but wrong in what he considered the structure to be,—the study of the latter part of the treatise will be of considerable interest.

From the interest that was excited temporarily in this country regarding the habits of the Forest Fly, attention was directed to it (very much through correspondence published in our journals the 'Field' and the 'Veterinary Record') elsewhere, of which some notes may be of use in connection with what may be called "our own" species in other countries, or species belonging to other countries, of which one kind at least, the *H. canina*, especially infesting dogs, and found in some parts of Europe, may possibly (if attention was directed to the subject) be found present with us.

HIPPOBOSCA EQUINA IN THE CANARY ISLANDS.—On the 29th of August I was favoured by Mr. A. H. Bechérvaise, writing from Santa Cruz, Teneriffe, Canary Islands, with the following letter, specimens being despatched accompanying:—"Having read your letter in the 'Field' of the 10th inst., I am sending you to-day a small box containing some specimens found on horses and pigeons, respectively, in this island. The natives say that the same fly attacks both animals, but this I am inclined to doubt. Parasitical insects of many kinds are very abundant in these islands."—(A. H. B.)

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* 'Etudes anatomiques et physiologiques sur les Insectes Diptères de la famille des Pupipares,' par M. Léon Dufour ('Annales des Sciences Naturelles,' 3 me Sér, tome iii., Janvier, 1845.)

On examination of the plentiful supply of specimens forwarded, those from the horse proved to be similar to our Forest Fly, that is to say, *Hippobosca equina*, Linn., of which Prof. Rondani observes that it not only infests horses, cattle, dogs, and other animals, in all parts of Europe, but that he has noticed specimens in the City Museum of Genoa and the Bellardi collections which were found in Africa and in the Canary Islands.*

With the Forest Flies were three puparia, of which Mr. Bechérvaise noted that the egg-like bodies "were deposited by these flies shortly after being placed in the bottle." These were the size and shape of the puparium figured at p. 95. One was still unchanged from the white colour with dark emarginate extremity of the puparia just after deposit; the two others had partially gained the brown colour.

Specimens of two other distinct species of *Hippobosca*—that is, of what we call in this country Forest Flies or Spider Flies—were sent me from British India. One of these kinds was forwarded as infesting dogs in the district of Cachar (Province of Assam, Further India); the other kind forwarded from Calcutta as common in Bengal, and, although found upon the dog, yet (like our own English Forest Flies) much more prevalent on the horse.

Dog Forest Fly or Spider Fly. *Hippobosca canina*, Rondani.

This species is stated by Prof. Camillo Rondani to be very similar to *Hippobosca equina*, Linn.,† and very easily confused with it, but distinguishable amongst other characteristics by its smaller size, paler colouring, and likewise the *scutellum* (the small transverse portion of the fore body immediately preceding the abdomen) being wholly above of an ivory-white colour, *not* rusty or rusty-red at the sides, but the central parts with a yellowish-white tinge. The veins of the wings of a reddish, *not* black tint.‡

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* 'Muscaria Exotica Musei Civici Januensis.' Observata et distincta a Prof. Camillo Rondani. Fragmentum iv. p. 164 (separate impression, p. 15). Estratto dagli Annali del Mus. Civ. di Sc. Nat. di Genova, vol. xii. 29, 30, Marzo, 1878.

† For description of *H. equina* see p. 97.

‡ For scientific investigation I add the distinguishing characteristics verbatim as given by Prof. Rondani:—

"*H. canina*, Rondn.—Sp. similis equinæ Lin. et cum eadem facilius confundenda, sed distincta, statura minore, pictura pallidiore, et precipue colore scutelli, The above characteristics were very noticeable in the Cachar specimens; the length of the flies from head to tip of wings folded as when at rest averaged about one-sixth less than that of our Forest Flies; ground colour of the body was paler and consequently less distinct from the spots than in our Forest Fly; and the difference of the *whole* of the upper part of the scutellum being white or whitish was very observable. The veins of the wings also were redder, but as there is some difference in depth of tint of these veins in our own *H. equina*, this distinction was not so marked.

The first observation of this fly sent in the past season was published in the 'Field' for August 3rd, 1895, p. 219; to which journal I acknowledge, with thanks, my obligation for the following good information:—

"The description and illustration of the Forest Fly contained in your paper of May 11th correspond almost exactly with a fly which is a parasite on the pariah dogs of the district of India in which I reside. I have often seen fifty or a hundred on the neck and chest of pariahs, and from these they find their way to European dogs, but trouble these to a lesser extent, being dispersed in the daily washings.

"They are pupiparous, and I have found their grub enclosed in a sac * in the long hair on the neck of my collie. They have the sidling motion and short flight of the Forest Fly, and the dogs find it almost impossible to get rid of one, such is the power of grasp of their hooked knife-like claws.

"I have often amused myself by grasping the fly by the wings between finger and thumb, then allowing it to catch the hair on the back of my other hand. So sharp is the claw, that the hair grasped by it is cut to shavings, like wood by a carpenter's plane. This is not noted in the letter of May 11th, where its power of raising the skin by its hold on the hair is mentioned, so I presume the fly I am describing has its knife-like claws sharper than those of the Forest Fly.

"A dog cannot kill one, the skin is so hard, but 'mouths' it with evident disgust, saliva flowing freely. The fly always escapes out of

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et partium oris. Illud in nostra sp. totum superne albicante sub-eburneum, non ad latera ferrugineum nec rufo-testaceum, macula tantum centrale flavido-albicante. Organo vero suctoria rufescentia vel lutescentia non nigricantia nec fusco picea; præterea vitta frontalis pallide rufa non obscure fusca; venæ alarum dilute testacea non nigricantes," &c.

"In tota Italia et in Europa saltem australe legitur cum sequente" [*H. equina*, E. A. O.] "permixta mammalibus variis molesta, et minus raro in canibus; sed examplaria speciei observavi Musei Civici Januensis in Persia lecta a March. J. Doria, et specimina collectionis Bellardi in Africa australe, et orientale inventa."—'Muscaria Exotica,' &c. (reference given p. 111).

* This "sac" will no doubt be the puparium (described previously, and figured at p. 95) containing the undeveloped fly.—Ed.

the mouth by the upper lip, and makes its way back to the hair of the neck. The flies are never seen on any other animals than dogs."—(J. B. D., Cachar, India, July 4th, 1895.)

The above remarks, it will be seen, embody a good deal of serviceably interesting information. For one thing, the still more easterly Asiatic locality beyond that of Persia, where the species was found by March. A. Doria; also the kind being only noticed in Cachar on dogs, and more especially on dogs of very neglected coats, notably the pariahs; and further the great power of the claws in so holding as to strip the hair so grasped into shavings.

Consequently on the insertion of the above letter in the 'Field,' some communication on the subject took place in India, during which I was favoured with the consignment of specimens mentioned above for identification, and once again the writer mentioned, "The fly is only found in dogs, especially pariahs" (J. B. D.). As the writer in his published communications has preferred only to use his initials, I have not thought myself at liberty to do otherwise.

In Prof. Rondani's notes of geographical locality (quoted pp. 111, 112), he mentions this *H. canina* being found throughout Italy, and in Europe at least in the southern parts, on various animals, "together with the *H. equina*"; and though a tropical or South European insect is not likely to establish itself here, still, in the great amount of transmission of animals at the present day, we may find the species present as an occasional pest, and therefore I mention it.

Indian or Spotted Forest Fly. *Hippobosca maculata*, Leach; *H. ægyptiaca*, Macquart (of Rondani).*

On the 4th of July I was favoured by Dr. Spooner Hart, of Calcutta (of the firm of Messrs. R. S. Hart Bros., Veterinary Surgeons to the Viceroy and Governor-General of India), with the following communication on the subject of what proved to be, to use its most generally known name, the Indian Forest Fly, *H. maculata*, Leach; this letter, and others subsequently sent me by Dr. Hart, giving a great deal of information useful in itself, and also for comparison regarding habits of other kinds of *Hippobosca.* After remarking that he wrote in consequence of reading a communication by myself on the *H. equina* published in the 'Veterinary Record,' Dr. Hart observed:—

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* The specimens of Indian Forest Fly sent me agreed, excepting in being of a deeper ground colour, with a type specimen of *H. ægyptiaca*, Macq., identified as such by Prof. Rondani, and kindly presented me from the Museo Civico di Genova; also they agree with the characteristic distinctions of this species given by Prof. Rondani in his 'Muscaria Exotica,' previously quoted. As, however, the *insufficient* description and figure of *ægyptiaca* given by Macquart in his Dipt. Exot. ii. p. 274, tab. 36, fig. 5 (1843), do not coincide with the specimens, it seems best, though I have given the synonym as above, only to use Leach's specific appellation of *maculata* here, as, besides not involving any possible confusion, it has the right of priority. I have to express my obligation to Mr. O. E. Janson, F.E.S., for being good enough to compare specimens of which I had not types with those in the British Museum, and also lending me various publications not now purchasable.—E. A. O.

"I am sending you by this mail some specimens of flies which strike me as being of the same family. They are common in Bengal and in other parts of India. The description you give of the habits of the fly, and likewise that given by Morgan Evans in the 'Field,' agree precisely with the flies which I am sending.

"The flies live upon the horse principally between the thighs, along the perinæum and under the tail. Some horses are driven mad even by the presence of a single fly, and in driving along not unfrequently start kicking most violently, kicking over the traces and shafts, and frequently running away with the carriage. In fact, so terrified do they become in many instances, that it is imperative to take them out of harness and lead them home.

"In other instances you will see horses standing perfectly tranquil with perhaps twenty or thirty flies crawling about between the thighs, and others with their heads buried in the skin, and from which position they are detached with difficulty.

"The fly, notwithstanding its powers of flight appear limited, is troublesome to catch, and killed with difficulty. Our syces (grooms) invariably pull the head off the fly, and then throw it away, but this does not stop it from crawling along.

"The fly frequently gets on the dog and buries itself in the hair chiefly along the back of the neck, but it never appears quite so happy and at home on a dog as upon a horse.

"Morgan Evans says 'it seems fond of taking short flights over the body in quick rushes, generally sideways like a crab, and at angles,' and this is perfectly true."—(S. H.)

These flies proved to be of the species originally named by Leach as the *H. maculata*, a very good and descriptive name, as the great number of little bright yellow patches, or spots, on the dark pitchy or black back are noticeable at a glance, and may well claim for it the name of the "Spotted" Forest Fly. Examined by the side of our own Forest Fly, the *H. equina*, it appears as generally slightly larger, and broader made. The back of the fore body is also much more varied in surface, the depth and curving of the depressions giving the more convex portions between them almost the appearance of lobes. The yellow spots, though at the first glance they seem irregular, in the specimens before me are arranged to some degree thus: one spot just at the back of the neck; on the shoulder a somewhat circular broken ring or square formed of one concave patch in front, and two concave patches confluent at the inner tips behind; along the centre of the thorax is a short thin yellow line spreading out into a patch on each side so as to form a kind of anchor mark, and behind this anchor mark is a row of patches, three or five in number, according to the centre group being more or less confluent; besides these there are various side patches. The scutellum is of the deep pitchy or black colour of the thorax, marked across from back to front with three yellow patches, the centre one being much the largest.

The above are some of the main characteristics of this species which may be distinguished with a fairly strong hand-magnifier. For those who wish to go into the scientific differentiation I subjoin the original description from the 'Memoirs of the Wernerian Natural History Society.' Characteristic differences of the nervures of the wings from those of other species will be found in Prof. Rondani's work, previously quoted, attached to the description given by him under the synonym of *ægyptiaca.**

Continuing now the observations of Dr. Spooner Hart, of Calcutta, on September 20th he favoured me with some further remarks on the Spotted Indian Forest Fly, the *H. maculata*, relatively to the presence of this kind on dogs, and the power and structure of its claws; likewise some observations on Ticks, which I give separately further on under this heading.

Dr. Hart remarked:—"You will remember I mentioned that the fly visited the dog, but did not appear to revel upon it, or was not so much at home upon it as upon the horse; and, speaking of Calcutta and other parts of Bengal, I have never seen the fly in such large numbers upon the dog as upon the horse; in fact, you seldom see more than one at a time upon the dog, whereas, as already stated, they may exist in large numbers upon the horse.

"My Forest Fly on the dog gets into the ears, or buries itself in the hair at the back of the neck in preference to other parts, and there it remains motionless, and apparently engaged with its head in contact with the skin, and its tail just peeping out through the hairs. It appears very stupid, and is with difficulty dislodged, and will leave the spot reluctantly when disturbed, and return to it again. Some dogs detest the fly, and get excited on its approach, whilst others take but little notice of it, and this is especially the case with pariahs or common dogs."

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* *Hippobosca maculata*, Leach, tab. 26, fig. 11–13.—*Hippobosca equina* ex India Orientali. Fab. Syst. Ant. 338, lin. 9. *Habitat* in India Orientali haud infrequens. Mus. Dom. Francillon, Marsham, MacLeay, Leach. Caput flavum: oculi piceo-nigricantes: labium pallidè flavum: haustellum nigrum; vagina nigro-atra pilis canescentibus vestita: frons flava; medio latè exarato obscuriore: clypeus politus flavus, medio tenuiter sulcato; margine pallido-brunneo; anticè acutè emarginatus; laciniis parùm divaricatis subtruncatis, posticè subrotundatus tenuiter emarginatus. *Thorax* piceus flavo-maculatus irregulariter profundiùs-strigosus, striis sæpe confluentibus quasi crenulatis: scutellum nigricans aut intensè nigro-piceum maculis tribus flavis transversè dispositis, mediâ majore, margine postico albo-ciliato: pectus nigro-piceum transversim strigosum: alæ anticè inter pterigostea hyalinæ, posticè obscuræ pterigostea picea basi flava: pedes fusco-lutescentes pallidè villosuli; anteriores immaculati; quatuor postici apice tibiarum annulisque femorum nigris; tibiis posterioribus medio nigris; tarsi picei; ungues atri. *Abdomen* pilis cinerascentibus velutinum; lateribus sæpe nudis luteo-fuscis.—Leach, 'Memoirs of the Wernerian Natural History Society,' vol. ii. p. 553 (1818).

The above notes of amount of infestation as noticed respectively on horses and on dogs refer, it will be observed, to the "Spotted" Indian kind, the *H. maculata*, regarding which Dr. Spooner Hart was writing; this, like our *equina*, appears to be especially the pest of horses, whilst the Cachar kind, the *canina*, though not limited to dogs, appears somewhat to prefer them.

The tearing and grasping apparatus with which the foot of the Indian Forest Fly is furnished appears to be quite as effective as that of our British species, as will be seen by turning to the figure of a claw of the *maculata* (at p. 99) showing the file-like side furrows and saw-edge.

Looking at some of the chief points of distinction between the three foregoing kinds of Forest Fly, it would appear that for general purposes they might be pretty surely known one from the other as follows:—

The *H. canina*, or Dog Forest Fly, smaller than either of the two other kinds, paler, and the *whole of the upper surface of the scutellum whitish.*

The *H. equina*, or Forest Fly (of this country), is of various shades of pitchy, with yellow marks on the fore body, and the *scutellum is dark, with one large central pale patch.*

The *H. maculata*, the Indian Forest Fly, is pitchy or blackish, with many yellow spots on the fore body, and the *scutellum is pitchy or blackish, with three pale spots, the central spot being much the largest.*

The considerations of prevention and remedy turn not only on use of applications to deter attack, and of treatment by which infestation when present can be got rid of, but also on such management of horses unused to the attack (when brought to an infested locality) as may make them acquainted with it without more danger or disturbance than can be helped.

Notes from various residents in the New Forest and its neighbourhood as to applications known to be of practical service, and regularly used in that especially infested locality, are given in the foregoing pages, especially at pp. 103 and 105, in the contributions of Mr. Gibb, and of Mr. Goodall, F.R.C.V.S., to whom I am greatly obliged for being allowed to publish such useful information.

In a communication sent me by Dr. Spooner Hart, of Calcutta, relatively both to Forest and Gad Flies, he mentioned:—"We find sponging the legs and bodies of horses over with weak phenyle-water very effectual in keeping flies off."

An application much mentioned in works of Continental entomology is a decoction of walnut leaves in vinegar; and in Dr. Fleming's translation of Neumann's 'Parasites, and Parasitic Diseases of Animals,' p. 39, it is mentioned that in many countries, as a preventive of fly attacks, "use is frequently made of a decoction of walnut leaves, or a maceration of them in vinegar. This need only be applied to the skin once a week. Sometimes it is sufficient to merely rub the animals with the walnut-tree leaves."

Anything that is poisonous to the flies, as, for instance, tobacco-water, if such application could be used without risk to the health of the infested animals, would be of service; or applications of soap, particularly with a little mineral oil in it, which would not only be deterrent by their smell, but also prevent the flies using their wonderfully elaborate foot structure with anything like completeness. The greasy state of the hairs would effectually prevent the file- and saw-apparatus of the curved claws having the hold by which each fly is enabled to devote six pairs of excellently adapted flat forceps to powerful and painful dragging at the hairs to which they are applied; also the greasy matter would greatly prevent all action of the lesser appendages, as the bearded hair, and the expanded membrane, and bulb.

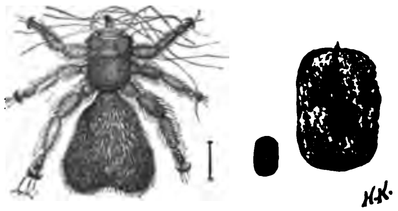
In the publications of the United States Board of Agriculture, kerosene emulsion is most strongly recommended as a trustworthy remedy for presence of "Ticks," and this mixture, or any mixture of soft-soap and mineral oil, if not too strong for safe use, appears to unite many of the points needed for remedial or preventive service.

The importance of all the measures of cleanliness so strongly advocated is obvious from the habits of the flies. From it being their nature to harbour in the coats of the infested horses or other animals, and when disturbed, for the most part, only to take short flights and return for comfortable harbourage, these special pests lie to an unusual extent under our power, and all such treatment as brushing, combing, or other means which will clear them (and also making sure they are killed in the clearing), cannot fail to do good. Care should also be given to clearing out the puparia, or little egg-like bodies (see figure, p. 95), which at first are white, afterwards turn to deep brown or black, from which otherwise flies would presently come out.

The observations at pp. 111—116 regarding the habits of the Dog Forest Fly in Cachar, and those of the Indian Forest Fly when on dogs, are well worth observation regarding the value of clean coats as preventives. It will be seen there that the infestation is especially found on the wild dogs, the pariahs, which are obviously animals of altogether neglected condition of coat, whilst the cared-for dogs, which are washed daily, are almost free. Also it is noted that down the ears and about the back of the neck, localities not well exposed to clearance of pests by the animal itself, are amongst the places on the dog where the fly chiefly establishes itself.

The above and other serviceable points will be found entered on in the foregoing observations. I much desire to add, lest the subject of *Hippobosca*, or Forest Fly, attack should appear entered on here at undue length, that this is partly on account of it being an infestation which has rarely been much entered on in this country. Partly also because I found in the course of my investigations that the literature of the subject was so little known of generally, and with regard to the great standard works so difficult to procure, and so costly, as to be very far from practically available; and, thirdly, such good assistance was kindly rendered me in the researches, that I have endeavoured to the very best of my power to present the information in a connected form, hoping it may be found of use, and also, and very particularly, that it may lead to further observation.

Sheep Spider Fly or "Sheep Tick." *Melophagus ovinus*, Linn.



MELOPHAGUS OVINUS and puparium, nat. size and magnified (puparium showing dried adhesive coating).

The Sheep Spider Fly, or "Louse Fly," or "Sheep Tick," as it is commonly called, is an infestation closely resembling that of the Forest Fly, both in its method of propagation and its habits. It only lives actively in fly state, and multiplies, not by egg-laying or deposit of ordinary maggots, but by deposit, or laying, of squarish bright chestnut-coloured pupa-cases, from which the flies presently emerge, and feed by blood-sucking.

The infestation is not so troublesome in some respects as that of Forest Fly, for the "Sheep Ticks" have not the power of running as fast as they can go, backwards, forwards, or sidelong, scraping and dragging amongst the fine hair, and on the tenderest parts of the skin, but, on the contrary, move slowly and quietly in the wool. Also, as these Spider Flies are *wingless*, there is no alarm given by sudden attack and burrowing in the hair, neither can the infestation be spread except by the flies crawling from one animal to another, as for instance from sheep to lambs, or to the animals lying on pasturage where the chrysalids or pupa-cases have dropped from the sheep, and the flies crawl to them on hatching.

In the course of last season such a good supply of live specimens was sent me, in wool from fleeces of sheep that had not been dipped, as to enable me to study them and their peculiar chrysalis-case personally; and though with this attack the requisite treatment is so thoroughly known that any suggestions are quite uncalled for, some short notes of the life-history of the fly itself may be of interest.

It should perhaps be observed that, though the name of "Sheep Tick" is so commonly and universally bestowed on the pest, at least in Europe and America, as well as in this country, it may be said to be the established name, still, really, it is not a "Tick" at all. The difference may be easily told by noticing that, except in its very earliest state, a true Tick has *eight* legs, and also it has no marked division between the fore body and abdomen (see figures of "Ticks").

The Sheep Spider Flies, or "Sheep Ticks," scientifically *Melo-*

phagus ovinus, are wingless, somewhat flat in shape, and leathery in texture, bristly, especially on the abdomen and legs, and of a brownish colour, varying in tint on different parts of the body and legs, and more or less tinged with grey on the abdomen. When seen in the wool they greatly resemble small spiders.

The head is squarish, rather wider than the thorax, in which it is partially sunk, and is furnished with a long proboscis; the eyes are remarkably small; the ocelli, or simple eyes, wanting; and the antennæ, or horns, which are very short and sunk in pits, are wart-shaped at the ends.

The thorax, as seen from above, is square and without wings, and, so far as observable, also without poisers. The abdomen is much contracted at the base, then enlarged into a flattish bag-shape, and more or less concave at the tail extremity. The feet, like those of the Forest Fly (*H. equina*), are terminated by a pair of strong black curved claws, each furnished with a much shorter and lumpy, or somewhat thumb-like, side claw, and a bearded bristle or feather-like appendage—of the same nature as the "bearded hair" of the Forest Fly's foot (figured and described in the foregoing paper), but much shorter, and broader in proportion, and the plumes of the feather, or hairs of the bristle, more definitely arranged on each side of the centre—is very observable.

Two good figures of this process are given by Dr. Cooper Curtice in plate iv. of his 'Animal Parasites of Sheep,' of which one shows the foot "with the two claws, between which hangs the pinniform prehensile organ"; also "the tarsi, whose last joint supports the prehensile organ"; this magnified sufficiently to show the structure. The other figure, magnified sixty times, shows the prehensile organ separately in greater detail—that is, the segmented muscular portion included within the tarsus, and the feather-like "flexible grasping portion." *

The lower edge of the curved claw is notched below in the same manner as that of the *H. equina* and *H. maculata*, but, as far as I find, not so markedly. The teeth, so to call them, are rounder and shallower, and I could not certainly distinguish the file-like side markings. Possibly, however, this might be from not examining into this part of the structure until the specimens had dried.

These flies belong to the division of the *Pupipara*. The maggot is hatched within the mother fly from an egg, according to Leuckart, long and slender, varying from one millimètre and a half to slightly more in length, and rather more than half a millimètre in breadth,* and within the parent fly the maggot feeds until it is full-grown, when it is deposited in a pupa-case. These "puparia" are not little round balls notched at one end like the pupa-cases of the Forest Fly, but flatter from back to front, and very bluntly oval in shape, with the two ends truncated, so as to be almost of a long-square shape, with the four corners rounded off.

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* 'The Animal Parasites of Sheep,' by Cooper Curtice, D.V.S., M.D. United States Department of Agriculture. Washington: Government Printing Office. 1890. (Paper on "Sheep Ticks," pp. 39–44.)

Also the colour is different. The Sheep Tick chrysalis-cases are of a clear bright chestnut, where they can be seen, but this is commonly more or less hidden by an incrustation of dried matter, which has to be cleaned off in order to see the smooth bright coat beneath.† In my own specimen (figured from life) it will be seen that about a third only of the surface was clean. In the excellent paper by Dr. Cooper Curtice on Sheep, published by the U.S.A. Department of Agriculture (quoted above), he mentions, regarding deposit of these puparia by the Sheep Tick, and the nature of the incrustation, that "they only lay one at a time in the wool. A portion of each puparium will be found to be covered with a dry dark substance, which came from the parent when the puparium was laid, was sticky, and glued it to the surrounding hairs. This prevents the pupa, which becomes dry, hard, and glassy, from falling from the wool." ‡

How many of these egg-like chrysalis-cases may be produced by one fly does not seem certain. Dr. Taschenberg mentions that successively—that is, from time to time—and taking the number of single deposits altogether, as many as eight puparia may be produced by one Spider Fly.

In due course the fly matures, and escapes from the case by cracking it across near one end. The only note I am aware of as to the time taken for development, is that of within four weeks at ordinary temperatures, given by Dr. Curtice from his own observations.

Very few attacks lie so completely under cure by treatment as this. It is most especially a sheep attack, though the flies have existed for a time on human blood, and they die soon if deprived of food. In the case of some scores sent me in wool from sheep which *had not been dipped*, though all circumstances excepting that of presence of food were comfortable for them, they died in a very few days.

The treatment, which appears to do all that is needed in the way of application both here and in the States, is the use of dips. On this point Prof. Wallace notes, in his 'Farm Live Stock,' speaking of these Sheep Ticks (known in Scotland under the name of Kades or Keds),

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* See 'Die Fortpflanzung und Entwicklung der Pupiparen nach Beobachtungen an *Melophagus ovinus*,' von Dr. Rud. Leuckart, p. 17. Halle, 1858.

† See 'Etudes Anatomiques et Physiologiques sur les Insectes Diptères de la famille des Pupipares,' by M. Léon Dufour, p. 84. (Previously quoted.)

‡ 'Animal Parasites' (before referred to), p. 40.

"They may be kept very much under by timely dipping, if not got rid of altogether." *

The different kinds of washes and dips, as also the time for application in reference to conditions of sheep, as well as circumstances of shearing time, repetition of dipping in order wholly to clear infestation, and all details, are so thoroughly understood by all interested in the subject, that it would be mere presumption on my part to say anything regarding treatment. But perhaps I may venture to draw attention to the book by Dr. Cooper Curtice, previously alluded to, published under the direction of the Secretary of Agriculture, U.S.A. It contains a great amount of serviceable information on internal and external parasites of the sheep most clearly given, embodying both the nature of the attacks in scientific detail, yet intelligibly to all, and likewise the treatment found to answer; each or almost every paper being accompanied by a full-sized good plate. It would be easily procurable, by order, from Messrs. William Wesley & Son (Agency of the United States Government Departments), 28, Essex Street, Strand, London, W.C. The title, put shortly, is as follows:—

Curtice (C.), 'The Animal Parasites of Sheep.' With Thirty-six partly Coloured Plates. Large 8vo, cloth. Washington, 1890. 12s.

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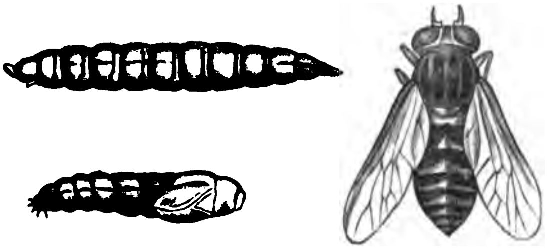
* 'Farm Live Stock of Great Britain,' by Robert Wallace, F.L.S., &c., Professor of Agriculture in the University of Edinburgh, p. 273.

TABANIDÆ.—Gad Flies, Horse Flies, or Breeze Flies.

Hæmatopota pluvialis, Linn., Horse or Rain Breeze Fly.
Therioplectes tropicus, Meig. (no known English name).
„ *solstitialis*, Meig., Midsummer Gad Fly.
Atylotus fulvus, Meig., Tawny Gad Fly.
Tabanus bovinus, Linn.,[*] Great Ox Gad Fly.
„ *autumnalis*, Linn., Autumn Gad Fly.
„ *bromius*, Linn., "Noisy" Breeze Fly.
„ *cognatus*, Löw, "Allied" Breeze Fly.
Chrysops cæcutiens, Linn., Blinding Breeze Fly.



TABANUS BOVINUS, Linn., larva and pupa, life size. After De Geer.

In the course of the attention which was directed during the past season to the presence of horse and cattle flies in the New Forest, some twelve or fourteen different kinds of what we commonly know as "Gad Flies," "Horse Flies," or "Breeze Flies," were sent me, with requests for the precise name. Some of the kinds were perfectly easily distinguishable, for all practical purposes, under their common names, as, for instance, the Great Ox Gad Fly, or the little straight-sided grey "Horse Fly," or, again, the pretty little *Chrysops*, with its banded wings; but with regard to the scientific names, all who are at all acquainted with the subject will know the impossibility of any but an expert giving a really trustworthy identification.

Therefore, after identifying to the best of my power from the living, or still fresh specimens sent me, I submitted samples to our eminent authority on these subjects, Mr. R. H. Meade, of Bradford, who was good enough to verify my identifications, and in the above list I give the names of the kinds sent which are most easily recognized without great research. I am also greatly indebted to Prof. J. Mik, of Vienna, for being good enough to present me with a small type collection of Tabanidæ, a truly invaluable help from such a skilled donor.

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[*] For observations on differences between *Tabanus sudeticus* as separated by Zeller from *T. bovinus*, Linn., see p. 127; but as the distinctions are quite indistinguishable except by experts, and these notes are meant for agricultural service, in which both kinds are well known as the Great Ox Gad Fly, I have retained the name of *bovinus*, with requisite explanation.—E. A. O.

The family of the Tabanidæ, commonly known as Gad Flies, Horse Flies, Breeze Flies, &c., are strong and mostly broad-made flies, varying in size in this country from about or little more than a quarter of an inch, to an inch or more in length, and from three-quarters of an inch to one or two inches in spread of the wings.

They are especially distinguishable by the formation of the mouth parts: the proboscis is short, and projects horizontally, and in the female encloses six, and in the male four, somewhat lancet-like instruments. It is terminated by two fleshy lip-like lobes, and is guarded at the sides by the maxillary palpi, which are large and two-jointed. The females only are blood-suckers; in the males the mouth parts are less adapted for piercing, and they live on the sweet matter in flowers, or on "sweet sap."

The compound eyes are very large, and often, especially in the males, nearly cover the head, and are frequently gaily patterned (whilst living) with spots or stripes of bright colours. The third joint of the antennæ is large, and often with such a decided notch as to give a tooth-like projection (see figure, p. 123). The simple eyes (ocelli) are said to be usually absent, or almost obsolete, though sometimes, as in *Chrysops*, three are present (*vide* Schiner).

The thorax is compact and thick, with hinder portion (scutellum) much developed. The wings rather deflexed, or laid flat, and with many veins; when at rest usually not laid over each other, but about a quarter or half open, or extended horizontally. The "alulets," or winglets (an enlargement of the membrane at the lower part of the hinder edge of the wing), large. The abdomen seven-ringed. The legs stout.

The figure of the Great Ox Gad Fly at p. 123 gives a fair idea of the above details so far as they can be shown without being much magnified.

The grubs (larvæ) do not live in or on the hides of horses or other animals, but those of the genus *Tabanus* (Schiner), which includes many kinds, live in damp earth or sand, or under decaying leaves and stems in damp places, and the grub of *T. tropicus* has been found to feed under ground in damp woods, from whence the flies greatly torment the horses in neighbouring meadows.* The grubs of the

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* See 'Exposition of English Insects,' by Moses Harris, p. 28, MDCCLXXXII. An old work in which there are short but very careful descriptions of many of our English horse and cattle flies, accompanied by coloured figures.

Chrysops are stated also to live in earth. So far as they are described, the *Tabanus* grubs, are cylindrical, somewhat largest about the middle, and they turn to the pupal condition not within the maggot-skin, but free, something in the manner of the Daddy Longlegs, or *Tipula* larvæ.

In the 'Classification of Insects,' by the late Prof. Westwood, Life-President of our Entomological Society, he remarks: "We are indebted to De Geer for the knowledge we possess of the transformations of this family"; and as still up to the present time De Geer's account of his own personal observations of the changes of the *T. bovinus*, Linn., from larval state up to the perfect insect continues to be the chief source of information on the subject, and cannot be surpassed in accuracy or excellence of description, I give the main points in my own translation from his 'Mémoires,' believing that the history of the changes, told almost in his own words, will be much more usefully interesting than a mere abstract of the scientific points to be deduced from them.*

M. De Geer, after remarking that the larvæ of the Tabanidæ (of which no author had spoken before himself) live in the ground, observes:—

"I have found many in the month of May whilst searching in the earth of a meadow, and having shut up seven or eight in a box filled with fresh earth, which I was careful to renew from time to time, I observed on the 12th of June, 1760, that one of these larvæ had taken the form of a nymph" [what at the present day we call a chrysalis or pupa, E. A. O.], "and that it had half come out of the earth, keeping the head and fore part of the body out of the earth, whilst the rest was buried in it.

"I searched the earth in the box to find the other larvæ, but there were only three remaining, without counting that which had changed, and these three larvæ assumed afterward similarly the form of 'nymphs,'—similarly coming half out of the earth. . . . I found there also one small dead larva, and as the other larvæ which had disappeared could not have got out of the box, there is every appearance that they had been devoured by those which arrived at transformation.

"The largest larva which I have had of this kind was nearly an inch and a half long when extended as much as possible, and two lines and a half in breadth at the middle of the body. It much resembles those of the large Tipulæ" [what we know popularly as Crane Flies, or Daddy Longlegs, E. A. O.] "which live in the earth.

"It is cylindrical, of nearly equal thickness throughout, but lesser towards the head, so that the anterior portion is conical and pointed, and the hinder part is also terminated in a cone, but much shorter than that of the fore part, It is divided into twelve rings, of which the terminal ring is nipple-shaped.

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* See 'Mémoires pour servir à l'histoire des Insectes,' par M. le Baron Charles De Geer, p. 214. Tome sixième. Stockholm, 1776.

"The colour of the larva is of a dirty yellowish white, . . . with seven roughish or somewhat raised bands of a blackish colour placed on the fore part of the fourth, fifth, and following segments to the tenth inclusive, and which encircle the body like hoops. These same segments have towards the sides and at the lower part some fleshy tubercle-like projections, which the larva can withdraw into the body or push out again at pleasure." [By the help of this contraction and expansion, and the use of the head-hooks at the same time, the *footless* larva carries on its somewhat worm-like progression.—E. A. O.]

"The little head is brown and shining, of a lengthened shape, and has two small short antennæ, and two large hard hooks of the length of the head placed above, but curved downwards. . . . When at rest it withdraws the head into the first segment, and this into the second, and then the fore part of the body is as thick as the rest.

"The nymph" [pupa] "of this larva is nearly an inch long" [see figure, p. 128], "and of the same thickness as the maggot, and of almost equal thickness throughout, excepting the last ring of the body, which is smaller than the rest. It has in general the appearance of those of the larger Tipulæ. . . . The colour of this nymph is of a greyish brown, darker on the abdomen. This is divided into eight rings, each one having along the hinder edge a fringe of long grey hairs; the last ring is armed at the end with six hard and scaly points, which serve to push the nymph half out of the earth, according to its custom."—(C. De G.)

It was at the end of about a month, or a few days more, that the *Tabanus* fly quitted the pupal envelope, which split all along the upper part of the thorax ("*corcelet*"), opening similarly on each side of the head, which thus detaches itself from the rest, and leaves free exit for the perfect fly. The identical specimen which emerged, and proved to be the *Tabanus bovinus* of Linnæus and De Geer,* is figured in plate xii. of the 'Mémoires' of De Geer (referred to at p. 125); the various stages are figured at 6–14; the male *T. bovinus*, or Ox Gad Fly, at fig. 10, and the female at fig. 11, and from these figures my accompanying figure is precisely copied.

The above description, from an observer of such high standing, is of great value.

The *T. bovinus*, Linn., the Great Ox Gad Fly, is four-fifths of an inch or rather more in length, and the length of each wing is about from three-fifths to three-fourths of an inch; the male is little if at all smaller than the female.

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* See for description, 'Fauna Austriaca: die Fliegen' (Diptera), by J. Rudolph Schiner, vol. i. p. 34.

The male has greenish eyes of one colour (that is, not striped or spotted). The thorax (or fore body) black brown, upper side shining, with five indistinct greyish-yellow stripes, and short, thick, mixed, brownish-black and yellowish-grey hair. The wings hyaline, yellowish-grey, and especially yellow towards the fore edge, the veins there of a bright to yellow-brown. Hinder body reddish-yellow brown, having above a central stripe, and tip of a darker or blackish tint, with, always, a triangular yellowish, or a triangular pale milk-white spot in the middle of the hinder borders of the first to the fifth segment. The second to the fourth segment with fine and short light yellow-brown and whitish hair at the hinder edge. Abdomen beneath orange colour; the three last segments, and a central stripe along all the segments, black-brown or shining black, or entirely covered with yellowish-grey powder. Legs black-brown; tibia (shanks) more or less yellow-brown; tarsi pitch-brown.

The female differs in the one-coloured eyes being of a bright green, with a coppery glow. The thorax and its appendages like those of the male, only brighter, and more clearly striped with grey along the back. The abdomen flatter, and more rounded at the end, not so pointed as with the male, but similarly coloured and marked; the white triangles in the dorsal line variable in size, and reach in the second, third, and fourth segments the front edge. The under side of the abdomen as in the male, but mostly orange only as far as the fourth segment, or by the side of the central stripe brown-grey, or ash-grey; behind this entirely black-grey.*

The females are noted by Dr. Brauer as "swarming about horses, cattle, and deer; the males soaring in woodlands and on somewhat elevated meadow-ground near water, not at the summit of mountains, especially in close sultry weather, in sunshine after rain-storms, or in early morning."

The great size and the colouring of the above-described fine insects distinguish them perfectly from all other of our British Gad Flies, excepting the kind now separated from them under the scientific name of *Tabanus sudeticus*, of Zeller. This is to some degree distinguishable from the above by its larger size, the females being from just under to just over an inch in length. The eyes (without cross-bands) are *not* bright green or greenish as in *bovinus*, but blackish or blackish-brown, with a coppery glow, and the hinder body is only orange-coloured for a short distance along the sides, the almost velvet-black colour predominating above. As in *bovinus*, there is a central row of spots; but when type specimens of the two kinds are examined side by side, the black ground colour of *sudeticus* catches the eye at once. Also it is considered to fly earlier in the year,—*sudeticus* in May and middle of June, *bovinus* end of June, July and August.

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* For full description see "Die Zweiflügler des Kaiserlichen Museums zu Wien," von Prof. Dr. Friedrich Brauer, pp. 105–216 of 'Denkschriften der Kaiserlicher Akademie der Wissenschaften,' Zweiundvierzigster Band, Wien, 1880 (*i. e.* Transactions of the Imperial Academy of Sciences in Vienna, forty-second volume).

For specific differences see references below *; but though the insects are distinguishable by experts, they are not at all so without types and full description, inappropriate here; therefore, as the early name *T. bovinus*, Linn., includes both kinds scientifically, and the name of Great Ox Gad Fly does so for all practical purposes, I have preserved the comprehensive name still often used.

Of the other Gad Flies mentioned, the Autumnal Gad Fly, *Tabanus autumnalis*, is one of the most noticeable. This is a smaller and much greyer fly than the above, not quite four-fifths of an inch in length. Eyes very dark, black or part grey, without cross-bands. Thorax black-brown or grey above, with five grey stripes. The abdomen above of a greyish red-brown in the male, black in the female, in both male and female with three rows of white or white-grey spots. The central row triangular; the rows (one on each side of the central stripe) of oval, usually white, spots placed slantingly from the inner and foremost to the outer and hindmost end of each spot.

Autumnal Breeze Fly (after Railliet).

T. bromius, sometimes known as the Noisy Breeze Fly, is also of a greyish tint, but smaller than the above, being only about half an inch long; and the eyes with *one purple cross stripe*,—in the females on a green ground colour, with a reddish glance. Like *autumnalis*, this kind has five grey stripes along the thorax, but they are more noticeable; also there are three stripes along the abdomen, similarly of a central row of triangular spots, and two slanting side rows; in regular course the central row whitish, the side rows yellowish, and this, together with the side of some of the foremost segments in the male being more or less of an orange colour, and occasionally something of the same tint in the female, gives the fly a more greyish-yellow colour; also it is somewhat hairy.

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* Brauer's 'Tabanidæ' (cited p. 127), pp. 184, 185. 'Dipterologische Beiträge,' von P. P. Zeller, in 'Isis,' p. 815, 2, plate i. fig. 5–8, 1842. 'Fauna Austriaca: die Fliegen' (Diptera), vol. i. p. 34. I may be permitted to add that in case any of my correspondents wish for information in more detail, I have Dr. Brauer's and Dr. Schiner's works above referred to in my own library. Prof. Zeller's work being only accessible with great difficulty, I have not the work itself, but large extracts and abstracts taken by myself from a copy kindly lent me by Mr. O. E. Janson, F.E.S., which I believe embody all requisite information.

T. cognatus, Löw (= *T. glaucopis*, Meigen).—Length three-fifths of an inch, or rather more. Eyes with two or three purple bands; ground colour partly grey and green in male, green in female. Thorax grey, bright black on the back, with five observable pale stripes. Abdomen may be generally described as black, with the hinder edges of the segments yellow, with a middle stripe, on each side of which is a stripe of spots of pale yellow. In the female the middle stripe formed of grey triangular spots. In the *cognatus*, noted by Brauer as probably only a variety of the above, the thorax is noted as of a darker grey, and the ground colour of the abdomen dark red-brown or chestnut-brown to the fifth segment; in the female the red-brown ground colour sometimes extends to the sides of the second segment observably, otherwise the segments black with smaller and greyer stripe along the centre, and pale yellow or orange isolated round side spots.

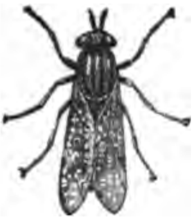
The specimen of the above species which I submitted to Mr. Meade as being (to the best of my power of identification) *glaucopis*, he noted he should rather conclude it to be *cognatus*, considered by Dr. Brauer to be only a variety of the *glaucopis* species, and I feel no doubt he is correct.

Sub-genus *Therioplectes*: *T. tropicus*, Meig.—Length averaging about three-fifths of an inch. Eyes of the male with fine and thick yellow-grey hair, three purple bands, and some green in the ground colour; of the female green, and also with three purple bands. Thorax black grey, with slightly observable stripes. Upper side of the abdomen with the first to the third segment orange, with nearly a third of the breadth of the segment occupied by a black dorsal stripe, the ground colour from the fourth to the last segment black.

Sub-genus *Atylotus*: *A. fulvus*, Meigen, "Tawny Breeze Fly," "Golden Yellow-felted and Orange-powdered kind."—Length slightly more than half an inch. Eyes of the male with thick and long yellow-grey hair, commonly without stripes; of female pale olive-green, with many black, round, bright points, and a fine sloping darker line. Thorax strikingly clothed with golden-yellow hairs. Abdomen with a dark stripe, yet of a general reddish-yellow colour, and the hair entirely of a golden colour. This species is easily distinguishable from the foregoing by its hairy or even felted appearance.

The above species are amongst the Diptera classed by Dr. Brauer and Dr. Schiner in the great division of the genus *Tabanus*, Linn., of which Dr. Schiner gives the general habits as follows:—"The larvæ live in damp earth, in sand, or beneath decaying leaves and stems in damp places. The flies are abundant on pastures, and by roads and paths, where they rest on stems of neighbouring trees, and on the look-out for horses and cattle, to which the blood-sucking females are very troublesome. The males also frequent flowers, or hover, especially in the mornings and evenings in sunshine, over the roads."—(See Dr. Taschenberg's 'Fauna Austriaca: die Fliegen,' previously quoted, vol. ii. p. 29.)

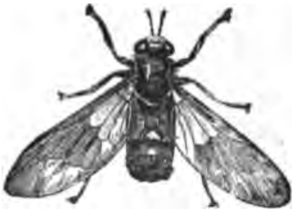
Two other very troublesome kinds remain to be noticed amongst those sent me from the New Forest, of distinct genera from the above. One of these is the *Hæmatopota pluvialis*, Panz., known sometimes as the Small Rain Breeze Fly, or Horse Breeze Fly. This is a little somewhat straight-sided fly, not quite half an inch in length; the males blackish-grey; the females whitish-grey; and both sexes much covered with white hair. The eyes, when living, green above, purple below, with bluish stripes, or one-coloured, with stripes. The wings grey, and covered with pale markings, in the shape of very short narrow stripes, forming straight or curved lines, or even parts of broken circles in all directions; when at rest, the wings are placed like a roof over the abdomen. Of this species Dr. Taschenberg says:—"An extraordinarily troublesome Breeze Fly." Schiner notes the flies as numerous by roads and paths, and on hot days attacking the draught animals, especially horses. Also as being always at hand near water in the height of summer, and annoying bathers; and so persevering in their attacks that they can be seized by the fingers, without their flying away.



Small Rain Breeze Fly, magnified (after Railliet).

The early stages appear to be still unknown.

Genus *Chrysops: C. cæcutiens*, Linn., "Small Blinding Breeze Fly."—Has distinct ocelli—that is, little speck-like eyes on the top of the head—three in number; and the antennæ (horns) longer than the breadth of the head, without crescent-shaped side notch. Wings, when at rest, expanded to about half open (see figure). Length from a third to two-fifths of an inch. General colour black in the male, but browner in the female, with a yellow band across the upper side of the base of the abdomen, bearing in the middle a dark marking somewhat of the shape of a capital X, with the centre of the upper part (that is, the part nearest the fore body) entirely dark; sometimes (*vide* Schiner's



Small Blinding Breeze Fly, magnified (after Railliet).

'Fliegen,' previously quoted) the male also has a similar mark on a yellow band. Eyes golden-green, with purple spots, and hind border or stripe. Wings in the male almost entirely black or blackish-brown; in the female somewhat lighter, or occasionally lighter, with two large pale spaces, dividing the dark part into three patches, one at the tip, a much larger one across the wing just beyond the centre, and a smaller one at the base, these being joined by dark colour along the fore edge of the wing.

Of this kind Dr. Schiner notes:—"Metamorphosis unknown; according to Fabricius they live in larval condition in the earth. The flies are often found near water in great numbers, and cause much annoyance to men and animals by their very persevering attacks. The two sexes are very different in their markings."—(Schiner, *op. cit.* vol. i. p. 40.)

On the 12th of May in the past year, in reply to some observations or enquiries of mine regarding prevalence of the Great Gad Fly in the New Forest, Mr. D. D. Gibb, of Ossemsley Manor Farm, near Lymington, Hants, to whom I was much indebted for information in the course of the investigations, favoured me with the following notes:—

"Your information as to the presence of the Great Gad Fly in the New Forest district is perfectly correct. Though not so plentiful as the Warble Fly, they are frequently too numerous to make themselves pleasant. I have seen a pair of horses, when at plough or harrowing in summer, have three or four of these flies upon them, you may guess with what result. Unless killed, horses become distracted by their blood-sucking propensities, and sometimes bolt with the plough at their heels. It is the combined attacks of these and other flies referred to which so terrify strange horses, and send cattle flying with tails in the air."

Some weeks later, on the 27th of June (after sending me specimens of various kinds of Gad Flies), Mr. Gibb mentioned:—

"Any number can be found similar to those sent. . . . Yesterday I observed starlings and wagtails following our cattle, and found they were catching Tabanidæ and other flies; the wagtails describing somersaults and other peculiar motions in their hunt. They are most invaluable birds as destroyers; I have seen them pursue their prey into the stable."

On the 6th of July Mr. Gibb sent me some further notes, which are interesting as showing the quantity in which the Tabanidæ appeared together with warm weather after rain, with some remarks as to relative amount of different kinds:—

"Yesterday and to-day the weather is very warm after the recent rains, which have benefited us much after ten weeks' drought, consequently these flies are again very plentiful." Consequently Mr. Gibb was able to send me a further supply, with the observation:—"I believe they will be found to differ little from the last, except I have succeeded in capturing one specimen of *Tabanus borinus;* these flies are now plentiful, but are most difficult to catch.

"Another kind difficult to capture, although frequently seen, is the largest dark-spotted fly with grey markings." [*T. autumnalis.*—E. A. O.] "*H. pluvialis* is not very numerous compared with the other kinds. I have seen them in Scotland by thousands. *Chrysops* is now very busy and plentiful; by the specimens you will observe that they vary in colour."—(D. D. G.)

On the 20th of June Mr. Moens, of Tweed, Lymington, Hampshire, obliged me with specimens of Tabanidæ, of which three proved to be respectively the *Tabanus autumnalis*, the *Hæmatopota pluvialis*, and the *Chrysops cæcutiens* (see previous pages for descriptions), with the following remarks:—

"I am sending you specimens of four sorts of flies which (as they say) 'terrify' our animals in the New Forest, besides the regular Forest Fly. The larger ones go here by the name of 'Stoats'; . . . the fly with the speckled wings, and the smaller one, are termed blood-suckers; they gorge themselves with blood, which they draw readily from horses. These are especially prevalent this summer, and are most troublesome in the hot close weather preceding thunderstorms."—(W. M.)

On the 24th of June Mr. Moens gave me a few more notes. Of the *Chrysops cæcutiens* he mentioned:—"This fly causes the blood to run down the horse's neck when it is gorged. I will try to secure more specimens, and send them alive; but, though very plentiful, and the forest is full of them, one must take horses and nets to get them. It is curious how our forest ponies go on the top of the rising ground, where there is a breath of wind, 'to shade' themselves out in the full sun, for the flies don't like the wind, and are always most troublesome in sheltered places."—(W. M.)

In looking over the past year's observations, firstly, with regard to the number of species of Tabanidæ forwarded, it is of some interest to find so many kinds in such a small area. In the above lists it will be seen there were nine distinct species, and others were sent, amounting in all to about thirteen kinds, some of which I was not able o identify with absolute certainty. There is no doubt that the *Hippobosca*, or Forest Fly, is a cause of great danger and annoyance; but it is worth observation, though not much mentioned, that these Gad Flies also play a very powerful part in trouble caused.

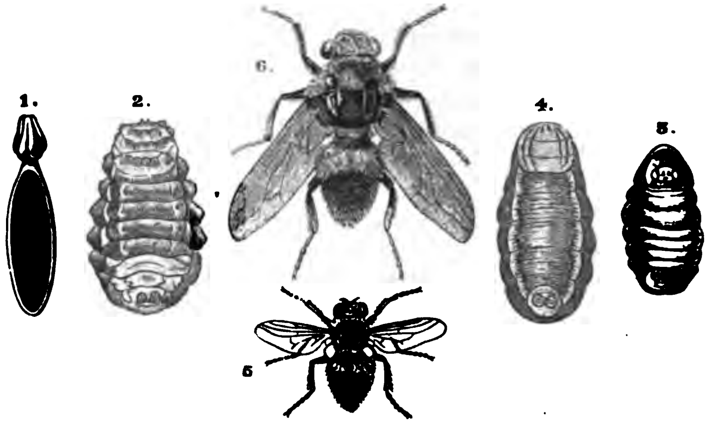
So far as is known, especially regarding the part of the family included in the genus *Tabanus*, the history appears to be that they pass their first stage of life as cylindrical grubs, very like those of the Daddy Longlegs (Tipulæ), and mostly in damp ground, decaying vegetable matter, and the like places; and when the time for the change to the chrysalis state arrives—this takes place much as with the Tipulæ before mentioned—casting off the outer larval skin, and completing development within a pellicle showing the limbs and shape of the forming insect, and from which it presently emerges by cracking open the skin, and leaving it remaining as it stood, partly fixed and upright in the ground.

There appears no possible way of getting rid of the insects (as in the case of other attacks) in larval condition, for we have no guide to where they may be lying in the woodland or damp locality.

The chief available means of prevention appear to be applications to the coats of the horses or cattle exposed to their attacks which may be obnoxious to the insects, and therefore deterrent. Some of these, like the application of weak phenyle, recommended by Dr. Spooner Hart, appear sure to be of service, and the remedies mentioned on the authority of Mr. T. B. Goodall, of Christchurch, and other residents in or near the Forest, could not fail also to be useful. Such measures of protection as nets, ear-caps, &c., to keep the insects to some degree from being able to get at the hide of the animals, are too well-known to need comment.

ŒSTRIDÆ.—Warble and Bot Flies.

Hypoderma diana, Brauer; Deer Warble Fly (Deer).
Cephenomyia rufibarbis, Meigen; Throat Bot Fly (Deer).
Hypoderma bovis, De Geer; Warble Fly (Ox).
Hypoderma lineata, Villers; Warble Fly (Ox).



HYPODERMA BOVIS.—1, egg; 2, maggot; 3 and 4, chrysalis-case; 5 and 6, fly; 3 and 5, nat. size, after Bracy Clark; the other figures after Brauer, and all magnified.

Early in the summer of the past year enquiry was sent me regarding warble presence in hides of deer, a matter on which, as it had never come under my notice practically, but only in reference to kinds of warble or other *Œstrus* flies injurious to deer, I was little able to offer information. As the subject, however, appeared to be of a good deal of interest, I obtained introductions to a few experienced superintendents and others, who, being personally interested in observation on a large scale of the condition of deer-hides, were fully qualified to give information regarding amount of infestation.

The notes I was favoured with showed, so far as they went, the *absence* of warble (that is, of the lumps caused by the great maggots of flies of the nature of the *Hypoderma bovis* so troublesome to cattle) on the fallow deer. Also some amount of infestation on the roe deer, but not enough to attract attention to it, excepting in collections of hides for business purposes. In the case of the red deer the warble attack was much more prevalent, so as to be noticeable as seriously injurious both to flesh and hides in forest observations, as well as to the pelts brought under examination for purposes of manufacture. This especially with regard to Scottish red deer, and to some extent in the case of those from English parks, but not so badly as with the Scottish pelts.

It was also observed that the warble-perforations were of two sizes, those in the roe deer pelts being smaller than those in the red deer. This would appear to point to there being two kinds of Warble Fly present, and further observations on this point would be of useful interest, for, in what I believe is our most recent authoritative list of British Diptera * (two-winged flies), mention is only made of one species of these Deer Warble Flies as being present in Britain. This is the *Hypoderma diana*, of Brauer, and is known to attack the roe deer on the Continent; this species and also the *Hypoderma actæon* attack the red deer, but, so far as I am aware, we have no information as to what species of fly it is which causes the great damage (alluded to further on) by the great number of *small* perforations it causes in grub state, and this would be a useful as well as interesting point to learn.

In regard to fallow deer. — The following note is from Mr. Christopher Chouler, gamekeeper to His Grace the Duke of Buccleuch, at Dalkeith Park, Midlothian, whom I was recommended to apply to as about the best authority in Scotland on this subject. Mr. Chouler wrote:—"I may say that I have been at Dalkeith twenty-one years. At first the deer numbered nearly six hundred, latterly they have been considerably reduced, and during that time have never seen any troubled with warble, but have occasionally taken the maggot out of my cow, which grazes with the deer. I have never known the warble attack fallow deer, but I recollect once seeing a skin of the red deer much damaged by them."—(C. C.)

In reference to the roe deer, the following remarks, for which I am obliged to Mr. J. Bell (gamekeeper), Drumlanrig Park, Thornhill, Dumfries-shire, N.B., show the warble attack not to have been to an extent noticed in what hides came under observation locally, though from other notes taken from inspection of general collection of hides, warble attack is found to exist with us on the roe deer. Mr. Bell remarked:—"I will not go the length of saying that roe deer are not affected with warbles in Scotland, but I must confess that I never noticed it. I have also asked some of my assistants here, one man especially, who has skinned a very large number in his time, but they also say that they never saw it.

"Had my attention been called to this matter a few years ago, it could have been very easily investigated, as we had then a large number of roe; but extensive young plantations having been planted, we had to put them down to a very small number, and now only an occasional one is killed. I shall, however, now pay attention to this, and should I ever find anything of the kind, I shall let you know.

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* 'List of British Diptera,' by G. H. Verrall, Fellow of the Entomological Society. London, 1888.

"Roe deer skins are so valueless, that after a day's shooting two or three men were generally told off to get the skins off as quickly as possible, the carcases cut up, and distributed amongst the poor people. By this you can understand that there was not much notice taken of the skins."—(J. B.)

In regard to attack on red deer, I had a few remarks from Mr. Tom Speedy, from The Inch, Edinburgh, noting very observable injury from warble presence, and from Mr. Speedy's experience, his knowledge as a naturalist, and also as the author of several books on sport, he could probably, if his leisure and inclination allowed, give us much useful information on the subject.

Mr. Speedy observed:—"With regard to warbles in deer. They are quite common; but I have been under the impression (I have not made a study of them) that they attack deer more in those forests where there is a scarcity of food. Some years ago I shot a number of hinds on ground that marched with Mr. ——'s * forest, where they were overstocked, and they were practically useless through the skin and flesh being destroyed by warbles. The flesh looks nasty round the warble."—(T. S.)

Infestation in young red deer's hide.—On the 22nd of January of the present year (1896), I was favoured by Mr. T. Speedy, of 17, St. Andrew's Square, Edinburgh, with an excellent example of warble attack then in full action in the skin of a red deer. The animal was still obviously quite young, possibly not more than two years old, for the hide was only, as measured when laid flat (not drawn out or stretched), twenty-one inches in length, by ten and a half inches in breadth, and contained upwards of one hundred and sixty warble-cells. From some of these the maggots were escaping; and in many cases the pellicle of tissue covering the maggot-cell on the under surface of the hide was so thin that the dark markings on the maggots within were clearly noticeable through it.

The warble-cells were in many cases placed so close together that the swellings were confluent, these in groups of from two to six or more, forming patches of warble-blistered surface from an inch or an inch and a half across, up to a great patch of more than five inches in length by three and a quarter in breadth, which was almost completely covered by the blisters—that is, by the more or less worked-away pellicle of the under side of the hide raised into lumps by the presence of the warble grubs within.

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* Name omitted for obvious reasons.

Of the fifty-five larvæ, or maggots, taken from the warbles, all but about three (which were more advanced in condition) might, I should consider, be very safely referred to the second stage of the larvæ of the *Hypoderma diana*, Brauer. As a general thing, identification of *Hypoderma* larvæ (especially whilst still not fully developed) is scarcely to be depended on from any but an expert; but still, in this instance, from the comparison with the fully detailed descriptions and series of figures by Dr. Brauer,* and other points noted further on, it does not appear possible that this infestation can be any other than that of the Deer Warble, known scientifically as the *Hypoderma diana*.

Almost all of the larvæ (that is, all but the three above mentioned) were white, and transparent, with the prickles, stigmata ("stigmenplatten"), and minute mouth parts, very dark or blackish. The size varied from about three-eighths of an inch in length, and rather over the eighth of an inch in breadth at the sixth segment, up to a length of five-eighths of an inch, with a breadth (at the sixth segment) of about a quarter-inch. The smallest specimens were almost parallel-sided; the broader and older ones somewhat more elongate-oval in shape.

On the upper side of the maggots (in their second stage) the prickles were disposed so as to form a kind of band of clusters across the second and third segment, and at the sides of the two following; but these were sometimes so indistinguishable that it was difficult to make them out clearly, even with the help of a two-inch focus glass. On the under side the maggot is marked down the centre from the second to the sixth segment (inclusive) at the front, and hinder edge, with bands of prickles; those on the fore edge often divided into spots; the seventh segment with only one cross-band at the hinder edge, or front prickles very small. The remaining hinder segments bare.

The three larger specimens were distinguishable at a glance by their different size, shape, and colour. These were about three-quarters of an inch long by three-eighths of an inch in breadth, and a quarter of an inch in thickness, and the colour was slightly ochrey; this more in the case of one of the specimens, of which the prickles were of a brownish and rusty colour, than of the other two. These were very pale, the prickles being so pale that in many of the bands it was difficult to distinguish them clearly; this paleness of the prickles pointing to the very recent change to the third stage.

The shape of the larvæ corresponded excellently both with the descriptions and figure given by Dr. Brauer; namely, of a larva of more slender form than that of *H. bovis* (our common Ox Warble Fly),

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* 'Monographie der Œstriden,' von Friedrich Brauer, p. 115, plate viii. figures of larva in first, second, and third stages.

and of a *long* pear-shape. The larva in this stage is much more beset with prickles than before its moult to the third condition. On the upper side from the second to the fourth, *or* eighth, in the middle of the fore edge, is a small group of fine small prickles; in my specimens in which the prickles are most observable, the groups are from the second to the seventh, and the narrow transverse bands of exceedingly small thorns sometimes found at the hinder edge of the fourth, fifth, and sixth segments, are also present. The side-swellings up to eighth or ninth segments prickly. On the under side the prickles are arranged from the second to the eighth segment (inclusive) in groups along the fore edge, and in rows along the hinder edges of the segments. On the ninth segment are two transverse rows; on the tenth one row of prickles; the eleventh bare.

The skin of the larva at this stage is very finely shagreened; and the stigmata brown or rusty in colour, and half-moon or crescent-shaped.

The chief points in the above notes are taken from Dr. Brauer's fully detailed descriptions in his work previously referred to, together with comparison of my own specimens, and are only offered as a guide to distinguish this species in some degree from our two other British kinds of warble infestation. Up to the present time (so far as I am aware) the *Hypoderma diana* is the only kind of Warble Fly known to infest deer in Great Britain, that is to say, the only species of *Hypoderma* of which the maggots infest the hide; therefore, the mere fact of the maggot being so found might be taken as strong presumptive evidence that it was of this species. Nevertheless, as sometimes one kind of warble attack is certainly not limited to one kind of animal, and sometimes there is great doubt as to what other "hosts" a given kind may affect, I have tried to the best of my power to go into the matter here, as in case of such a thing as the Ox Warble Fly attack being extended to deer, should be found to occur, it would be a matter of no small practical importance.

The following notes, with which I was favoured by Messrs. R. and J. Pullman, 17, Greek Street, Soho Square, London, W., are of very useful interest, as being taken from investigation of the great number of deer-hides sent to their hands for purposes of manufacture.

Messrs. Pullman observed with regard to fallow deer:—"The marks of bot or warble have never been noticed on the pelts of fallow deer.*

"The Scottish roe deer pelts are frequently seen very badly 'bot-marked'; but the 'bot-holes' are smaller than in the red deer pelts, and some are so full of small 'bot-holes,' it seems as if a charge of shot had riddled the pelts.

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* Here Messrs. Pullman made some remarks on presence of "Ticks" on fallow deer, which I give in the following paper.

"Red deer.—The Scotch red deer pelts are all more or less infested with marks of 'bot.' The marks extend down the back, each side of the spine. They are much worse in the hind pelts than in the stag pelts, but that is accounted for by the stags being killed earlier in the season, and the maggot not having come to perfection; but the place where the pelt has been punctured is easily seen, and in the process of dressing a hole or deep scar appears in the leather.

"The hinds are more badly damaged than the stags, and very often the 'bot' is seen on the flesh side of the pelt; they are often quite as large and seem to resemble the chrysalis-case, fig. 4, of the Bot Fly." [See my figure of chrysalis of Ox Warble or Bot Fly at p. 184.—Ed.] "The 'bot' mark is also seen in the red deer pelts from some of the English deer-parks, but not so bad as in the Scotch skins, and the chrysalis has not been seen, but the marks are similar to those in the Scotch stag pelts."—(J. P.)

The *Hypoderma diana*, more especially known as the Deer or "Venison" Warble Fly (the Hochwild Hautbremse in Germany), is easily distinguishable from our Ox Warble Fly by its smaller size and greyer colour. It is slightly under half an inch long, whereas the Ox Warble Fly is rather over half an inch in length, and when the two kinds are placed side by side, this variously striped and mottled, but still general grey-brown colour, with the black base to the abdomen, distinguishes it at a glance from the bright black velvety banding of the Ox Warble Fly across the central portion both of the fore body and the abdomen, together with the upper part of the base of the abdomen being yellowish, and the tip orange. In some fresh specimens of this species before me, this colouring shows very beautifully.

The maggot also is smaller than that of *H. bovis*. Likewise in its third stage, more slender in shape, and of a long pear-shape.*

It might be of service, and it would be of a good deal of interest, to know something more of the Warble Fly attack in connection with the red deer to which demonstrably it does much harm; and in regard to the roe deer, it certainly would be very desirable to make out the precise species of the infestation which causes the small perforations, and if I am favoured with specimens in the coming season, I should be glad to do my best to identify them.†

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* For full description of *H. diana* and larva, see 'Monographie der Œstriden,' von Friedrich Brauer, Wien, 1863, pp. 113–117, with figures; plates ii. and viii.

† The Red-bearded Bot Fly, *Cephenomyia rufibarbis* (Meigen), a newly-observed British Bot Fly, parasitic on red deer. This infestation (found in Ross-shire, N.B., in the summer of 1894, by Mr. L. W. Hinxman, and identified by Mr. Percy H. Grimshaw, F.E.S., who has paid particular attention to the study of the Diptera)

Ox Warble or Bot Fly, *Hypoderma bovis*, De Geer.—The observations of the past season have confirmed those for which we were previously indebted (in numbers too large to count) to our stock-owners, cattle-breeders, and likewise veterinary surgeons, of the trustworthy serviceableness of the simple means of greatly lessening presence of this infestation where the treatment advised is carried out according to direction.

But still there is great need of more action. The old "grandmother" story of maggots an inch long lying in the putrid lumps they have caused being a proof of the thriving state of the animal still holds its ground to a degree which keeps back useful work; so does also careless and ignorant mis-statement of measures of prevention and remedy.

A *general* rubbing of the back of an infested beast may be confidently trusted to, to do *next to no good* in destroying warble-maggots in their "boils." The thick hair of the beasts, and the smallness of the opening into the warble-boil, will very often prevent the dressing resting on the aperture so as to choke, or entering through it so as to poison, the contained grub. To answer our purpose, the dressing—whether of McDougall's smear, or any other of the many serviceable applications which are well before the public from other good manufacturers—*must* be put on the opening of the warble. Then (*and then only*) they can be trusted to, to destroy the maggot.

Consequently I believe that squeezing out the maggot, where the back of the animal (enjoying the "infestation proof" of its excellently improved health !) is not too sore and inflamed to bear touch, is the surest method. Boys with light hands can do this excellently, and a very small bonus for warbles produced would pay well. We hear

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has not come under my own observation, but—having been favoured by Mr. Grimshaw with a copy of his published observations, and it being an undeniable thing that an infestation causing presence of maggots of upwards of an inch in length at the back of the throats of the infested animals is of some importance—I take leave to give a short note of the attack from Mr. Grimshaw's paper.

During June and July the females (he mentions) lay living maggots at the open nostrils of the red deer. These adhere by their mouth-hooks, and work themselves on until they arrive at the back of the throat, where they lie until nearly ready to turn to chrysalids, and are then ejected by the coughing or sneezing of their host. The maggots are then twelve to thirteen lines long, of a general dirty yellow colour. They go into chrysalis state very shortly after leaving the throat of the deer at the base of walls or under leaves, and from the chrysalids the fly appears at a time of from twenty-one to forty days, or much longer in cold weather. The fly is very hairy; "cheeks with a beautiful tawny beard"; fore body with a transverse band of tawny towards the front, hinder part black; abdomen above densely clothed with hair, of a dirty yellow on the two basal segments, black on the third and fourth, and white from the fourth to the apex. For details of his observations see Mr. Grimshaw's paper in the 'Annals of Scottish Natural History,' July, 1895.

yearly of a bonus at so much a head for queen wasps; but if, instead of a penny or sometimes more apiece, a penny a dozen was given for the warble-maggots, it would soon open the eyes of farm-workers to the existence of what is passed by merely because, in the expressive northern term, "they cannot be *fashed.*"

Also it holds back progress very much for recipes which have been proved to answer well for checking or preventing some part of the mischief, to be brought forward as suitable for some other part, or as a cure; it discourages those who are at the trouble of applying them, and from a misappropriation of the use of the following treatment in advice I noticed published (in almost precisely my own words) last year, I think it right to mention that, as will be seen, I only advise it to *prevent* fly-attack:—

"To prevent fly-attack in summer, train-oil rubbed along the spine, and a little on the loins and ribs, has been found useful; so has the following mixture:—4 oz. flowers of sulphur, 1 gill spirits of tar, 1 quart train-oil; to be mixed well together, and applied once a week along each side of the spine of the animal. With both the above applications it has been observed that the cattle so dressed were allowed to graze in peace, without being started off at the tearing gallop so ruinous to flesh, milk, and, in the case of cows in calf, to produce." This recipe will be found on the third page of my leaflet on 'Warble Prevention' (still for gratuitous distribution to all who desire it), and the application is excellently successful for the purpose named. But it is not a *cure;* it does not *destroy the maggots,* it only deters attack.

I am not aware that anything further is needed to extirpate warble attack than to use the measures which we know to answer; but how the use of them is to be brought about beyond the range of the vast number of cattle-owners, farmers, veterinary surgeons, and others, who steadily use them, and prove what good always follows on their use, I cannot tell; but, so far as lies in my power, whether by gratuitous distribution of leaflets, reply to enquiries, or by any other means open to me, I shall be proud and happy to give all the aid I possibly can to the cause of prevention.

A few remarks seem also now to be called for on the *Hypoderma lineata*, Villers, the Ox Bot or Warble Fly of the United States, sometimes also known as the Heel Fly, of which the work in this country (if it is really present with us to the extent to be credited with any work worth mention) has hitherto been classed together with that of our common Ox Warble Fly, the *H. bovis.*

This *H. lineata* is known to be present in this country *; and so far back as the year 1815 it appears to have been known of as present by Bracy Clark, but looked on by him as the male of our *H. bovis*, and also then and since under doubtful synonyms.

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* See 'List of British Diptera,' by G. H. Verrall, F.E.S., p. 20.

As, however, this fly and its maggot are almost indistinguishable from our well-known kind, excepting by skilled and careful investigators, and also its method of *damage* to hides, and its history in the later parts of its life, are similar, it appeared to me superfluous to enter on the subject.

Now, however, circumstances are different. Since the year 1892, in which a most carefully detailed paper of observations of what the whole life-history of this *H. lineata* was considered to be, by skilled official investigation and record of results on the part of the U.S.A. Department of Agriculture, was published in their official 'Bulletin,' a wish has been expressed to me from the late entomologist of the U.S. Department, Prof. Riley, and also from his able successor in office Mr. L. O. Howard, that I would endeavour to find how far our British warble attacks coincided with those of the States. Therefore, besides my own endeavours in the matter, I give first, and mainly from the paper referred to, some of the chief points of the infestation, to facilitate comparison of the habits of the two species.*

This *H. lineata*, Villers, of Europe and America, is slightly smaller than our *H. bovis*, from half a line to a line less in length, besides being less in bulk, and of a lighter make. One marked difference in colouring is that the black upper portion of the fore body, and the band across the middle of the abdomen above, are of a brown-black, not of the beautiful velvety black of our *bovis*. Also the front, sides, and back of the head, sides of the fore body, a band across the base of the scutellum, and the basal segments of the abdomen, are covered with long yellowish-white, almost white, hairs; the terminal segment of the abdomen is reddish-orange. The fore part of the fore body (thorax) is dirty white, and along the top are four prominent raised lines. The figure of *H. bovis*, p. 134, will give, with differences noted, a fair idea of the appearance both of the fly and maggot of *H. lineata*.

Of this (*lineata*) the maggot is stated to be more slender in shape, and more rugose than that of our *bovis*, and, when it has escaped from the warble, of a greyish-brown colour, striped with whitish-grey, and *not* of the browner tint, nor of the thick rounder shape of the larva of our Ox Warble Fly. Also it is shown in diagrams after Brauer (p. 311 of work above referred to) that in *H. lineata* the terminal segment only of its larva is entirely bare of spines; whereas in the larva of *bovis* both this and the preceding segment are without spines.

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* See "The Ox Bot in the United States; Habits and Natural History of *Hypoderma lineata*," by C. V. Riley ('Insect Life,' vol. iv. (Nos. 9 and 10) pp. 302–317. Bulletin of the United States Department of Agriculture, Washington, 1892).

These distinctions, however, are difficult of observation, excepting by those used to the work, and *the* important, and really very extraordinary, difference between the two kinds, *so far as the U.S.A. observations show at present*, lies in the method and locality of development of the larva in its earliest stages.

It is considered as established, by the writer and editor of the paper above quoted, mainly on the authority of skilled and minute observations by Dr. Cooper Curtice, D.V.S., that the early part of the infestation is conducted as follows:—

The eggs of the *H. lineata*, which much resemble those of our *bovis* (see figure at heading, p. 134), are laid in rows up to as many as of ten eggs in number on the hairs of the cattle, for the most part on the hairs near the heel (whence the name of "Heel Fly"), or, if laid elsewhere, mostly on the flanks or legs near the heels. By means of the licking of the cattle, the eggs, or rather the hatching larvæ contained in them, *are considered* to be conveyed into the mouth, from whence the little maggots pass into the œsophagus, or gullet, and there it is considered to be proved that they adhere in some way by means of their spines, and pierce through the wall of the œsophagus; the larva at this time being from eleven to fourteen millimètres long—that is, about half an inch. Here it is said to moult off its somewhat prickly skin, and take on the smooth skin of its second stage, in which "for eight or nine months it wanders slowly in the tissues of its host." During the late winter *it is considered* to reach a point beneath the skin in the region of the back, and to penetrate it, tail end foremost, and then again to moult, this time reassuming a spiny coat, and after its long journey to pass the rest of its existence in the way only too well known to us in the case of our *H. bovis*.

So far as has lain in my power I have endeavoured to ascertain whether the *lineata* was present here as a known infestation, and whether the special points, as that of maggots being observable in the œsophagus (or gullet) of cattle, or signs of perforation, were noticeable, and also whether any such maggots had been observed in the tissues. *Hitherto I have quite failed in obtaining information of such being the case.*

Through the chairman of one of our leading butchers' associations especially attending to warble attack, I was allowed to bring the subject before the members, but none of them, in the course of dealing with carcases under their hands, had observed any such presence; nor my own more specially personal enquiry, either with veterinary or practical observers, could I find that these points had been observed. I enquired very particularly by word of mouth as to observation of maggots in the gullet, and I certainly think that, if these occurred at the size mentioned (p. 313 of paper quoted), they would absolutely certainly have been observed.

I certainly think that, if *lineata* was here to any observable extent, we could not fail to have had notice of the eggs. These being placed in rows on the hair near the heels would, or at least I believe they would, attract attention fully as much as those of the Horse Bot Fly. *But I will now take the opportunity* of asking British observers who *may* read these notes to be so obliging, in *case* they find specimens, as to favour me with *a few.*

But the chief point of enquiry was with regard to similarity in characteristics of attack between the two species, and here it seems to me there is marked difference. The *lineata* flies (p. 307 of paper cited) are said to occur at time of egg-laying in "extraordinary numbers." With our *bovis* the difficulty is to see them at all, that is, on reliable authority,—there is plenty of information of fly-attack, which, on being run up, is usually of a Gad Fly, most commonly *Tabanus bovinus*, Linn. With us the main time for laying is the middle of summer, or, taking the edges of the average, from June to September; in the notes quoted, the *lineata* is seen in January, about a hundred observed in February, and on March 1st the fly is out in numbers, and in full tide of oviposition. This is an important difference, for the length of time taken for a *lineata* maggot to progress from gullet to hide (in paper quoted) is "eight or nine months" (p. 316). In my examinations of *bovis* I found the young maggot, just large enough to perceive with the unassisted eye * when removed from the little bloody spot in which they lay beneath the hide, on the 12th of November, which, taking the 1st of August as the middle average date, gives a much shorter time (that is, rather less than half the time) in the case of our maggot to that named as the time taken in the case of the American maggot for progress from egg to existence at the base of the hide.

The little maggots were prickly, and lay full of blood in the slight swelling of the subcutaneous pellicle of the hide caused by their presence, to which attention was drawn by its livid colour and the surrounding inflammation.

I devoted great care to making vertical sections of the hide, and found the channels, or rather passages, as fine as a hair from the sore to the surface, *not* to be smooth at the side, as if caused by pressure (as I noticed at the time), but torn as if by gnawing. I did not find any half-completed passages *from below* upwards; but I did find one half-completed *from above* downwards, at the bottom of which lay a minute body, which was so much crushed by the scalpel that I could not speak with certainty of its nature, but from similarity of the passage with the others I believe it to have been a young maggot piercing its way downwards with its mouth-forks.

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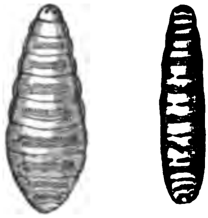
* I did not take the measure in millimètres, or part thereof, my work being needed for agricultural service, for which the minute measurement was uncalled.

At the next advance in growth, in which I had opportunity of observing the maggot, it was still straight-sided (see figures below), and somewhat worm-like in shape, about a quarter of an inch long by a third of that measure in width, and prickly; the next obvious change, though still very small, was to a somewhat club-shape, and the prickles now were observable, when magnified, as being in sixteen short bands, placed for the most part in very narrow and broader stripes.

At the time, I took very careful observations, with microscopic preparations of my specimens, some of which I still preserve,—some of spiracles and other details; but the important point relatively to the present enquiry seems to me to lie in the size of the larvæ, as observed in the American experiments, in the œsophagus, and by myself in the subcutaneous tissues of the hide.

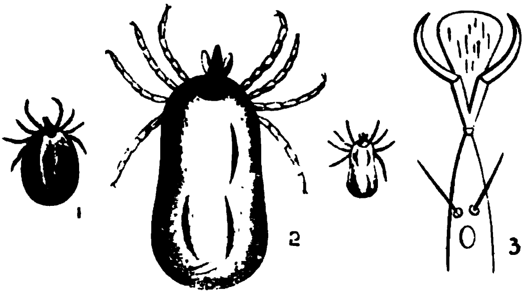


Larvæ of *Hypoderma bovis.*—Worm-like specimen, four times natural length; club-shaped, slightly less magnified.

In the American paper previously quoted (p. 818), the measure of the larvæ found in the œsophagus, considered to be in the second stage, is stated to be from eleven to fourteen millimètres (that is, a little less to a little more than half an inch). In my own observations I found the young maggot lying at the base of the fine gallery up through the hide to be of a size *only just perceptible to the naked eye;* and this appears to me to prove that our attack is wholly different from that alluded to in the American paper; for a larva which was half an inch long when it started from the gullet could not by any possibility be confused with one which was only just of a perceptible size, noticed in the beginning of its subsequently observed progressive growth beneath the hide. Should, however, the American attack of maggots in the gullet be observed in the course of the coming season, I should be greatly obliged by specimens for examination.

IXODIDÆ.—Ticks.

Deer and Dog Ticks. *Ixodes ricinus*, Linn.



1, Ixodes ricinus (Deer and Dog Tick), female; 2, I. erinaceus (Hedgehog and Dog Tick), female—nat. size and mag.; 3, Claw of Ixodes, mag.

"Ticks" are perfectly well known (especially to sportsmen and to those who have much to do with dogs) in their feeding conditions, when swelled up, by the blood they have sucked from whatever animal they may be infesting, into a smooth, shining, somewhat ball- or bean-like shape, attached to their host so firmly by the mouth-apparatus that, if pulled off without great care in detaching, they almost certainly either leave their proboscis behind, thereby causing a small festering sore for each Tick removed, or tear away a little piece of the surface-skin, which also causes a sore spot temporarily.

In this *shape* they are well known; but when non-inflated, and amongst grass, or in other places detached from animal presence, they are often not recognized as being the well-known pest, only in another condition or stage of life; and thus the origin of the infestation, or the kind of locality in which the Tick attaches itself to suitable animal hosts, is often not connected by observers with subsequent presence of the somewhat injurious and very repulsive-looking pest.

"Ticks" are not insects; they belong scientifically to the great division of *Acarina*, or Mites, and are distinguishable from insects by having *eight* legs, excepting in their earliest condition, when they have only six.

They are propagated by eggs. Out of these eggs the larva hatches with six legs, and in this condition, it is stated, may be found on the fur of various wild animals, but apparently without a necessity for feeding. After a while they drop to the ground, and, it is considered, probably go through their transformations in the ground to the pupal state. In this they become possessed of *eight* legs, and now they live on their host-animals, "with the rostrum implanted in the skin of their host, penetrating sometimes beneath it, and causing the formation of purulent tumours."

When the duration of the pupal condition has ended, and the time come for change to the male and female states, they again fall to the ground, and again transfer themselves to the skin of such suitable hosts as may pass their lurking-places, "to be nourished on the small quantity of pus produced at that point in the skin where their barbed rostrum is implanted, as happens with certain *nymphæ* and also males,* or to feed upon blood only, as occurs with the fecundated females." When satiated and swollen up—partly with blood, partly with eggs forming within—the female Tick falls to the ground, and under some protection lays "an immense number of eggs agglomerated in a mass, with which she remains for some time in contact, and subsequently the (now empty and shrivelled) female dies. The eggs produce the little six-legged Ticks in from fifteen to twenty days.†

The feet are furnished with two claws (see figure, p. 146); and the feeding apparatus consists in what may be generally described as a rostrum, or dart, furnished on the lower side with teeth set backwards (see also p. 151 for further details). Consequently, when this is firmly driven into the skin, all attempts to pull the Tick off usually fail in doing anything beyond tearing away its body and leaving the proboscis behind, or tearing away a portion of the skin; but at its own pleasure it can withdraw the feeding apparatus.

Ticks are to be found on many kinds of animals, from man down to snakes and tortoises; in the course of last year an unusually large Tick was forwarded to me from a field near Luton, which I was entirely unable to connect with any reason for it being there until, on investigation, it appeared that one or more tortoises had been turned out on the grass. The quadrupeds infested may be dogs, deer, camels, cattle, horses, mules, and sheep, amongst domesticated animals; but though some kinds—as, for instance, the *Ixodes ricinus* (the so-called Dog Tick)—have popular names bestowed as connecting them with special animals, yet one kind may be found on so many animals that this is no great guide in identification, and likewise colour and form may vary in many kinds with sex, age, and condition.

In regard to the so-called "Dog Tick," the *I. ricinus*, also to be found, sometimes in great numbers, on deer, I give the following note of measurement, showing differences of size and colouring under different circumstances. Female, *when fasting*, oval, orange-coloured, about two lines long by one and a half broad. When swollen by food, &c., somewhat like a small thick bean in shape, and leaden in colour, five to five and a half lines (that is, nearly half an inch) long and three lines broad. It will thus be observed that the female when inflated is twice as wide, by nearly three times as long, as when in ordinary condition. The male is one line and about one-third long, and three-quarters of a line broad, the body always flat, "entirely covered on its upper surface by a dull brown shield."

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* According to some writers, there is still an uncertainty as to the nature of the food of the male Tick.

† For excellent history of Ticks (Ixodidæ), with practical considerations thereon, see 'Parasites and Parasitic Diseases of Domesticated Animals,' translated by Dr. Geo. Fleming from the original German work by Prof. L. G. Neumann, pp. 95–105. As, although the general points of the history of the infestation are fairly well known, I am not aware of the details being so clearly and usefully entered on elsewhere as in the above work, I have availed myself of it for the above short abstract, with thankful acknowledgment.—E. A. O.

The Ticks (apart from their living hosts) especially frequent bushes and shrubs, and low-growing plants, and when young can creep about actively, and from the grass-blades, or branches, attach themselves by their legs to any bird or animal which comes within reach, and proceed to pierce into it with their barbed mouth-apparatus.

This attack is one regarding which enquiries are not unfrequently sent me, mainly in relation to dogs; but in the course of last year much more extended application was made, including among specimens the so-called "Sheep Tick," really the Spider Fly, sent as the true *Ixode;* also specimens sent found in large numbers in coincidence with Forest Fly on horses in Calcutta; and notes of damage done by Ticks to deer-hides, of which I was favoured with observations, forwarded amongst others regarding damage by warble to deer.

The differences between the true Tick and the "Sheep Tick," the *Melophagus ovinus*, will be seen at a glance by comparing the figures of the eight-legged Ticks at p. 146, and the "Sheep Tick," or Spider Fly, at p. 119.

The presence of the Tick amongst the Forest Flies may naturally lead to confusion as to their possible connection, from both pests having the habit of adhering by their suckers, and also the roundish, shiny Ticks having some degree of resemblance to the round shiny puparia of the Forest Fly, and regarding this attack I give the good observations with which I was obliged by Dr. Spooner Hart further on.

For information in regard to the presence of Ticks on deer, I am obliged to Messrs. Pullman, of Greek Street, Soho Square, London, who, in the course of the observations which they favoured me with, at my request, regarding amount of warble infestation on different kinds of deer, also alluded as follows to the prevalence of the "Tick" on fallow deer to such an amount as sometimes to injure the hides. After mentioning (see p. 188), "The marks of 'bot,' or 'warble,' have never been noticed on the pelts of fallow deer," they observed as below: "The only insect that causes any damage on fallow deer is the 'Tick,' a little insect of a red-brown colour, of the size of a 'Ladybird.' This Tick is sometimes found in the flanks of the pelts, and it sometimes extends up into the fore-quarters; they are more frequently found on the buck than on the doe.

"The damage is done by bites, which do not appear to go through to the flesh-side; and it is found, when the skin is dressed, that there is a poorness and unevenness in the leather. But as it very seldom extends through, it appears therefore that the insect derives its sustenance from the hair-side of the skin, unless it has a fine piercer to puncture the pelt; but no hole can be perceived in the pelt, and nothing on the flesh-side observed to denote that any damage has been done.

"There are many of the largest English deer-parks, in which fallow-deer are more domesticated and well looked after, where this insect is never seen."

With regard to Tick-presence on red deer, the further information was added, "that in the case of the Irish red deer the hair-sides of some pelts are 'Tick' (*not* Bot) marked all over."—(R. & J. P.)

Of course various kinds of Ticks may be present, but the so-called "Dog Tick," *Ixodes ricinus*, is known to be found on deer, as well as many other animals; and in Prof. Beneden's remarks on this species he particularizes the roebuck as being sometimes badly infested by it. "Some years ago it was propagated in an extraordinary manner on roebucks in the woods of the Duke of Arenburg, in the environs of Louvain." *

The following notes on presence of Ticks on dogs in Calcutta were sent me on the 20th September (1895), from Calcutta, by Dr. Spooner Hart, who was then favouring me with information regarding the presence of the Indian Forest Fly on horses and dogs; and in their careful detail they will be found of serviceable interest for this country also. Dr. Hart wrote:—

"During certain seasons of the year dogs in Calcutta and other parts are infested with hundreds of what we call 'Ticks.' There are two [forms] of them, and they exist on the skin, more or less mixed up together, during the same season of the year. I am sending specimens of them by the same post.

"One sample, you will observe, is encased in a tough lead-coloured covering, with the legs projecting, and it crawls along but slowly.† The other sample, to the naked eye, is perhaps somewhat like the bug. The *former*, as you will see, grows to a great size. It buries its head deeply into the skin of the dog, and it requires quite a little pull to detach it; and when trod upon they go off pop, and are found to be filled with black blood. Disgusting things to look at, grow rapidly in size, and can be seen projecting well through the coat, and hanging to the skin, they exist comparatively in small numbers compared with the 'bug' form, which, if allowed free fling, grow and thrive and exist in hundreds.

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* 'Animal Parasites,' &c., by P. J. van Beneden, Professor at the University of Louvain, p. 142.

† This is the swollen female, the flat bug-like form corresponding with description of male Tick.

"Found principally in clusters attached to the skin, between the toes of all four feet, in the ears, back of the neck and along the back, and, in fact, in almost all parts of the body. When detached by picking they leave bleeding apertures in the skin.

"During the season, if dogs are permitted to live in the house, you will find these insects crawling about the floors and up the walls in great numbers. I have had the 'bug' form fix on me, and cause quite a sharp bite; but as a rule they only crawl on you, apparently endeavouring to get away.

"The best remedy in the dog against these Ticks is cleanliness and daily picking, and to change its location day by day. You may pick a dog one day until he appears perfectly free of the insects, and in another two or three days you will find him just as bad as before. They set up great irritation in the skin, and in some cases a falling off in condition.

"The pupa [like] form wants a lot of killing whilst hanging on to the skin, and a medicinal agent sufficiently strong to do this would injure the skin. The 'bug' form, which crowds between the toes, can be made to readily leave their hold and die by putting the dog's foot in a cup of kerosene. The pupa [like] form exists upon the skin in all sizes, from the tiniest pinky-coloured insect to the full-grown specimens which you see."—(S. H.)

The plentiful supply of specimens of all sizes sent me showed the aptness of Dr. Spooner Hart's descriptions (conveyed in ordinary expression, not technical language) of the appearance of the infestation.

A large number were of a bluntly oval shape, bearing (except in the presence of legs, as observed by Dr. Hart in a portion of his communication to myself) a strong resemblance to the pupa-cases of various insects. The "bug" form was flat, of a shape technically described as ovo-triangular, that is, somewhat pointed before and rounded behind, the length rather more than one-sixteenth of an inch, the breadth rather less. These were presumably the males; the largest of the "pupa-like" forms were fully-developed females; and as Ticks are stated to have in their early conditions the characters of species modified by the attributes of their age, it appeared that the great number of bean-like Ticks, which ranged in length from little creatures about the sixteenth of an inch to rather over three-eighths of an inch, were young, up to developed, females.

The fully-developed females were much distended, and the mass inside, now hardish, was red, as if coloured with the blood they had sucked. The shape a thick oval, rather over three-eighths of an inch long by a quarter broad, and from over an eighth to somewhat under a quarter of an inch in thickness. The description of Dr. Hart, that when trod upon they go off pop, and are found to be filled with black blood, conveys an only too graphically correct description of the condition of the truly disgusting female Tick.

The colour of the specimens could not be judged of, after long soaking in preservative fluid, as a guide to what it was in life. But now, in the case of the large-developed females, it is a rich full deep red; the smaller specimens, and the smallest of all especially, have more variety of tint, some being of much lighter red, some few of an almost orange or ochre tint. The very flat specimens (? young males) were of a kind of rather pale brownish colour.

All the specimens were advanced to the stage of possessing eight legs,—in the case of the little ones, very long in proportion to the size of their bodies, giving at a glance the impression of their activity; whilst those of the adult females stuck out from the side of their inflated bodies, as if movement would be matter of much difficulty.

Some of the Ticks still held attached to their mouth-apparatus the piece of skin which they had torn away on removal. The smallest of those which I noticed so furnished was one-eighth of an inch in length, and gave a very nice example of their method of feeding. The two side processes (maxillary palpi) were held well apart by the piece of skin, which was still so firmly retained by the barbed rostrum that it was only by holding the Tick so securely as to crush it in, and pulling steadily at the bit of skin, that I was able with some difficulty to remove it. But, on clearing it away, the barbed rostrum (the "maxillo-labial dart"), and its pair of "chelifers," with their terminal hooks, which, together with the dart, form the instrument for penetrating the skin, were excellently observable with a one-inch microscopic power, the maxillary palpi being also well displayed.

The apparatus was in excellent accordance with the figure of the under side of the rostrum of the *Ixodes ricinus* (after Delafond), given at p. 96 of Drs. Fleming and Neumann's 'Animal Parasites,' previously referred to. The only point which I could not perfectly ascertain was the number of rows of recurved teeth or barbs beneath the rostrum. There was certainly a single row near the edge on each side of the centre; but there were, *between these*, three rows of some raised formation; altogether forming, when viewed with a one-inch object-glass, a kind of long patch of five rows, one central, two on each side along part of the under side of the rostrum. With the quarter-inch glass the shape of the recurved row on each side showed well, but I was not able to ascertain the nature of the three rows of intermediate processes.

In regard to methods of prevention, cleanliness in all branches—whether in regard to the state of the animals themselves or clearing infestation from wood in dog-kennels, or from paved or other localities, by scaldings and dressings and special washes, which may destroy the young Ticks in their lurking places whilst going through their changes of condition—is obviously useful.

Where the creatures are not so numerous as to make special applications to them dangerous to their host animal, a little drop of paraffin oil, or benzine, or tobacco-water, or even common oil, is a convenient means of making them loosen hold.

In the U.S.A. the application of the soft-soap and mineral-oil mixture, known as kerosene emulsion (for recipe, see p. 68), is recommended in the official publications of the U.S. Board of Agriculture as an absolutely sovereign remedy.

But with this attack, and most of the animal attacks preceding, I much wish to draw the attention of my readers to the point that *I do not presume to give advice*, on my own authority, on measures of treatment which cattle owners, sheep farmers, and those connected with regular management of horses and other animals, whether scientifically or practically, *cannot fail to understand much better than myself.*

But in the foregoing pages I have endeavoured to give what falls into my own department—namely, such account as I am able of the habits and life-histories of the infestations as may give a clue to the conditions in which remedies and treatment may be brought to bear on them; and in doing this, accompanied by the notes of treatment which I have been favoured with from known and skilled observers and veterinary surgeons, I trust I shall not be considered to have gone beyond what I may without intrusion lay before my readers.

BOOKS REFERRED TO

IN

PRECEDING PAPERS ON ANIMAL ATTACKS.

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